The Welding Engineer

NEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

lume XXV June, 1940 Number 6

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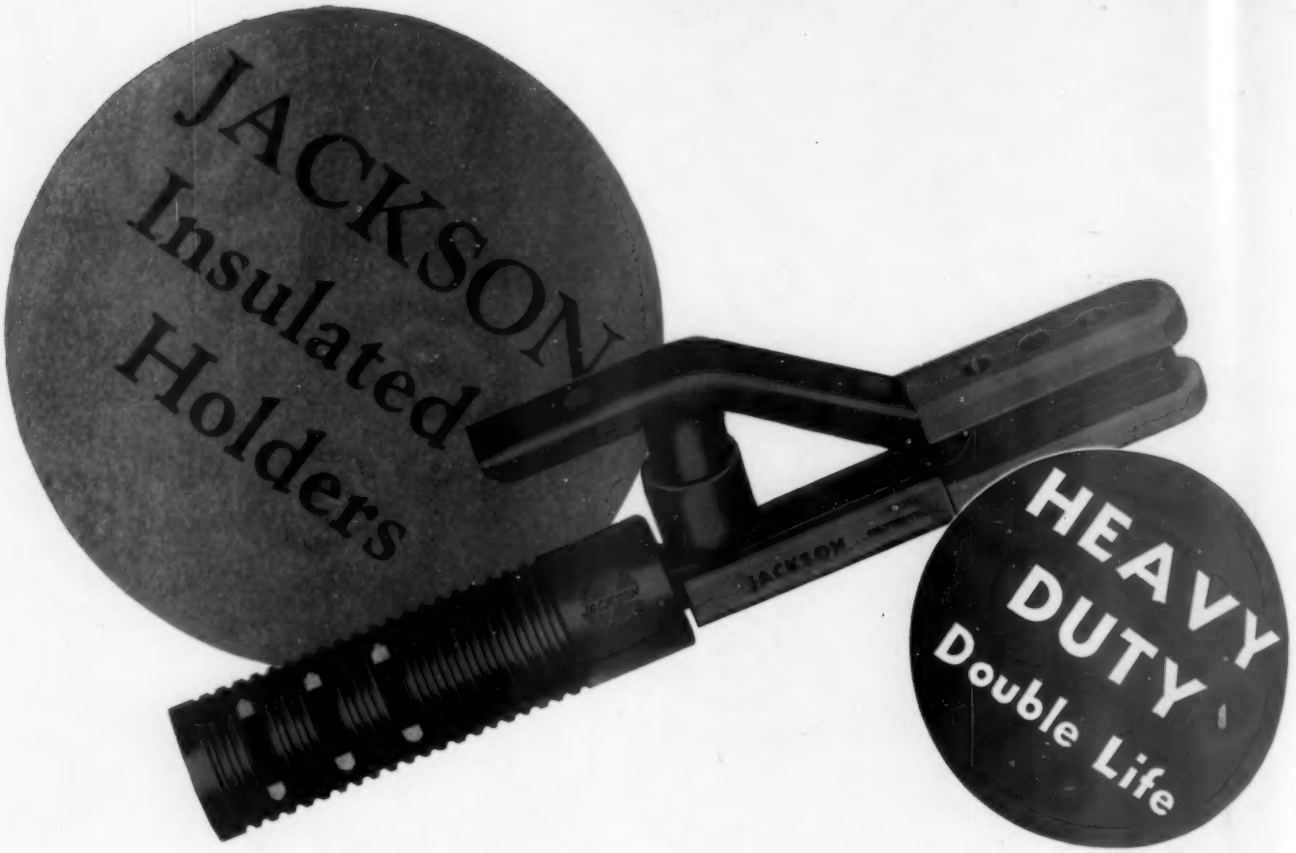

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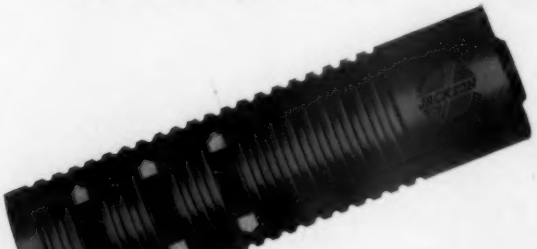

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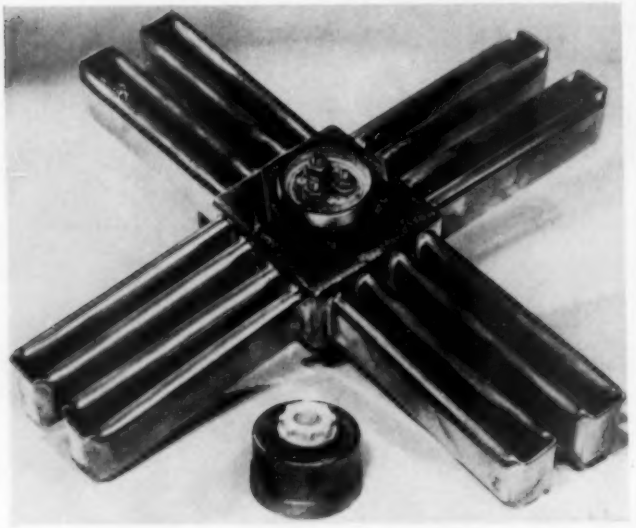
Brief Sketches of Welding Jobs



There are 16 silver alloy brazed joints in this immersion type electric heater.

Joining Thin Alloy Tubing to Cast Brass

★ In making an immersion type urn heater, the Harold E. Trent Co. of Philadelphia, Pa., had a problem of joining eight flat tubes to a cast brass center. The tubes, as illustrated, are of copper, but to meet some conditions alloy steel tubes are used. An electrical heating unit must be assembled inside the tubes before the joint is made. After fluxing the brass center and the tubes, the unit is assembled on a frame or jig and heat is applied with a torch. There are 16 joints, which normally have to withstand pressures up to 100 psi. and must stay leak-tight under conditions of repeated heating and cooling.

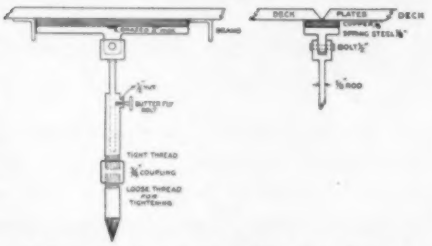
The thin section of the tubing makes it desirable to keep the heat as low as possible. The brazing alloy used, Easy-Flo, was selected because of its low flow point—1175 deg. F. and because its silver content assured a ductile joint with strength as high as that of the tubing. By concentrating the heat on the heavier cast brass center, joints are made without damage to the thin metal tubing. As the center section reaches a dull red heat, the brazing alloy is applied to the joint and the heat is shifted momentarily to the tubing to assure a uniform brazing heat. The finished joints are smooth and even, requiring no finishing work. The same brazing alloy is used on both the copper and alloy steel tubing. The free flowing and rapid penetration of the brazing alloy make this a fast and economical method.

» «

Back-Up Gadget Simplifies Single-Groove Welding of Plate

By M. FALCONVITCH

★ In a recent inspection of a welded deck plate on a small oil tanker, I noticed a poor job of welding. At some points the welding penetrated completely through the plate and at other points there was hardly any penetration. This could have been avoided to a certain extent by properly tack welding the plates, but even then there are cases where the welder attempts to fill up grooves much wider than are accepted as good practice.



This gadget helps the welder who has to make single-vee welds in deck plating.

By using the back-up gadget shown in Fig. 1, the weld metal will find a support and the welder will be able to obtain 100% penetration. This simple gadget can be easily made at very small cost. It is particularly helpful in ship building. With five or six of these gadgets available, the welder will save a lot of time. By its use, single-vee grooves can be used, eliminating the necessity of many double-vee welds.

» «

Smoke Stack Repaired by Welding

★Craftsmen Welders, Inc., of Brooklyn, N. Y., recently handled a smoke stack repair job for a Brooklyn Utility Co. This was a 230-ft. steel stack, 23 ft. in diameter at the base and 12½ ft. in diameter at the top. The repair job consisted of renewing the top 90 ft. of stack by welding on new steel. To increase the strength of the stack, all circumferential seams of the remaining portion of the stack were welded. Two sets of heavy steel angle reinforcements were also welded to the stack.

Among the advantages claimed for welded construction of stacks are:

The top 90 ft. of this 230-ft. steel stack was repaired by welding.

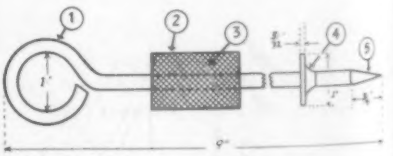
(1) Structure is more rigid and this reduces swaying to a minimum, (2) The seams are permanently tight, (3) The stack possesses greater strength.

» «

Milk Can Puncturer

By ARTHUR HAVENS

★ Very often the housewife is confronted with the simple but aggravating task of punching a pair of holes in the top of a milk can. This is generally accomplished with the aid of the best butcher knife or the ice pick. The point of butcher knife or ice pick is placed in position on top of can and then hit with the palm of the hand. As a rule this abuses the implement too much and is not a safe practice. Shown in this sketch is a simple easy-to-construct little gadget that will do the trick safely and without breaking any of the kitchen tools.



This will safely puncture milk cans.

The rod of slide bar is made from a piece of ¼-in. welding rod. Dimensions of the hammer are inconsequential as long as it is heavy enough to strike a blow that will puncture a milk can top easily. In using this gadget, the point of the tool is placed in position on top of the can and the hammer is raised and then struck against the welded washer. This simple tool serves the purpose nicely and saves many an early morning burst of temper.

Whence Come "Fish-Eyes"?

FISH-EYES are in the limelight, if we can judge from the interest developed in recent research work on the characteristics of fish-eyes and the speculation as to their probable origin. We do not consider ourselves an authority in this highly specialized field of "underwater" metallurgy. However, a recent letter from Bela Ronay, senior welding engineer, U. S. Naval Engineering Experiment Station, Annapolis, Md., offers some fruitful food for thought on this intriguing subject:

"The brilliant metallography performed by Miss Ferguson in connection with her investigation of the nature of 'fish-eyes' in weld metal is fully appreciated*," says Mr. Ronay. "Miss Ferguson has undoubtedly revealed the nature of a phenomenon. However, her discovery identifies the phenomenon in the same manner as a biologist identifies or 'isolates' a hitherto unknown bacillus. Identification of a bacillus does not necessarily mean the elimination thereof and the next and obvious step is to ascertain where and how the virus enters the organism. Herein I wish to point out some possible sources of fish-eyes:

"(a) Non-metallic inclusions are present in all commercially produced steel, be it cast, rolled or wrought and yet there is no record available to the writer of fish-eyes ever being found in testing commercial steel products.

"(b) No fish-eyes (silky-texture, light-colored, double-shear cups) were ever found by the writer or his associates in stress-relieved weld metal obtained from test coupons produced under normal methods.

"(c) Transverse checks or cracks may be found in single-bead deposits laid on unpreheated rigid material such as heavy plate. Similarly, transverse checks appear when a heavy deposit is built up unpreheated and when the interpass temperature is permitted to sink to that of the surrounding air. Under such circumstances the natural contraction of each pass is prevented by the stiffness of the underlying cold mass, causing the development of microscopic transverse checks which in testing become fish-eyes. In the event the filler metal produced under the above condition is developed in passes or layers less than 0.1 in. thick, it is possible that, in spite of the low interpass temperature, the entire mass of the deposit is fully recrystallized and still may show fish-eyes when tested, regardless of whether the test is performed with the material in the 'as-welded' or stress-relieved condition.

"(d) Filler metal deposited into test coupons with the interpass temperature kept about 200 deg. F. is not subject to the development of microscopic transverse checks, but may contain striations of course grained material amounting to 15 to 35% of the entire volume. Test specimens taken from such deposits and tested in the 'as-welded' condition usually contain fish-eyes, located invariably within a course-grained stratum.

"From the above considerations the following conclusions appear to be justified:

"1. Fish-eyes occurring in test specimens taken from filler metal (arc welded), produced under normal conditions as to interpass temperature, *develop in the course of testing* and, since they occur only in material tested in the 'as-welded' condition, their presence must be attributed to the difference of ductility between the fine and course-grained strata of the material.

"2. Fish-eyes occurring in filler metal specimens taken from fully restricted assemblies, or from welds developed with the inter-pass temperature at or below that of the ambient air and which may be entirely free of striations and tested either in the 'as-welded' or in the stress-relieved condition *are the outcome of incipient cracks* which developed in course of the drastic quenching of each pass as deposited.

"It is but natural that failure in all these cases should occur through the weakest cross section; i.e., that which contains the largest amount of non-metallic inclusions. Thus it is obvious that Miss Ferguson's brilliant work resulted in accurately locating an effect. The cause, however, remains inseparably connected with the history of the deposit and, as pointed out, it is stress development in one type of deposit and non-uniformity of some physical properties in the other. It may be added that were Miss Ferguson's conclusions correct, the use of filler metal in dynamically-loaded assemblies would be inadvisable.

"Fortunately, the normally present non-metallic inclusions in filler metal are harmless, as proven by the results of fatigue tests performed with the material in the 'as-welded' and stress-relieved conditions. Fatigue tests are performed with the stresses within the elastic range, therefore, the difference in ductility between the course and fine-grained strata does not play any role whatsoever, because ductility is a plastic property which manifests itself only

(*Continued on page 48*)

* "Fish-Eye Fractures in Weld Metal," by Mildred Ferguson, pages 22-23, April, 1940, issue, *The Welding Engineer*.

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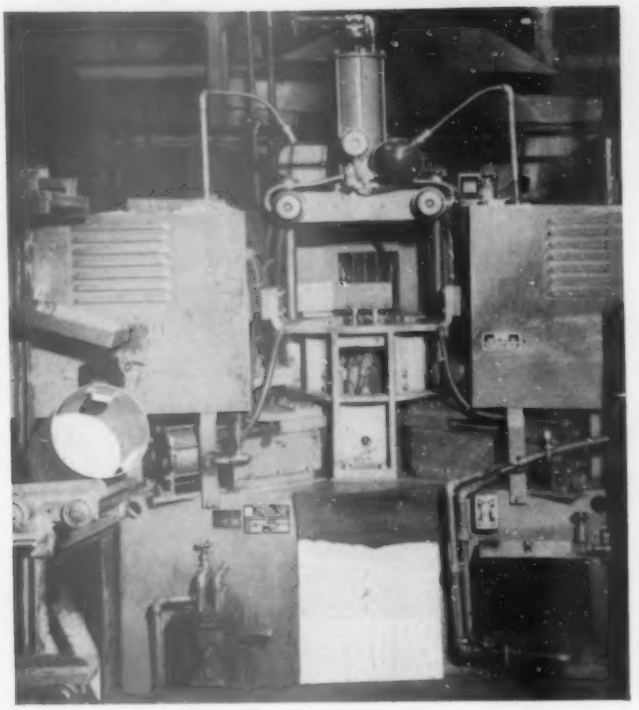

Fig. 1—This multiple projection welder is used to weld 3 bumpers and 2 screws into compressor shells. Photo (General Electric Co.)

Application of

Resistance Welding to

Electric Refrigerator Units

By E. R. SPITTLER

Welding Engineer, Refrigerator Dept., General Electric Co., Schenectady, N. Y.

THROUGHOUT the manufacturing field, where weldable materials are used, the resistance welding process has become widely used as a fabricating tool when high production of various parts is required, in such industries as refrigerator, automotive and toy. When properly designed clean parts, a welding machine of suitable design with correct type of electrodes, thyratron control (synchronous electronic control), and a proper power supply are used with careful supervision, no trouble should be experienced in consistently producing sound welds and perfect assemblies.

The refrigeration section of the General Electric Co., Schenectady, Works, affords an excellent example of various types of spot, projection, and seam welding, as used in manufacture of electric refrigerators.

The illustration, Fig. 1, shows a welding machine used to projection weld three bumpers and two oil distributor screws into the compressor shell, in one horizontal and one vertical stroke, of the welder. The welding current is switched by electronic control. One of the particular items of this welding job is the tolerance allowed on the area and height of projections. The length and width of the projection is held within plus and

Fig. 2—Welding valve body to compressor shell. Photo (General Electric Co.).

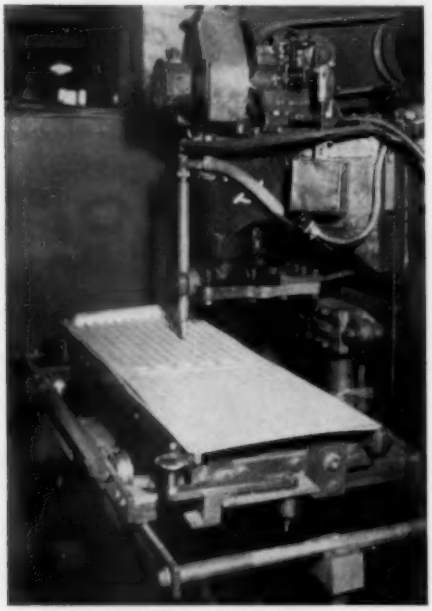

Fig. 3—Assembly spot welding of the stainless steel refrigerator evaporator. Photo (General Electric.).

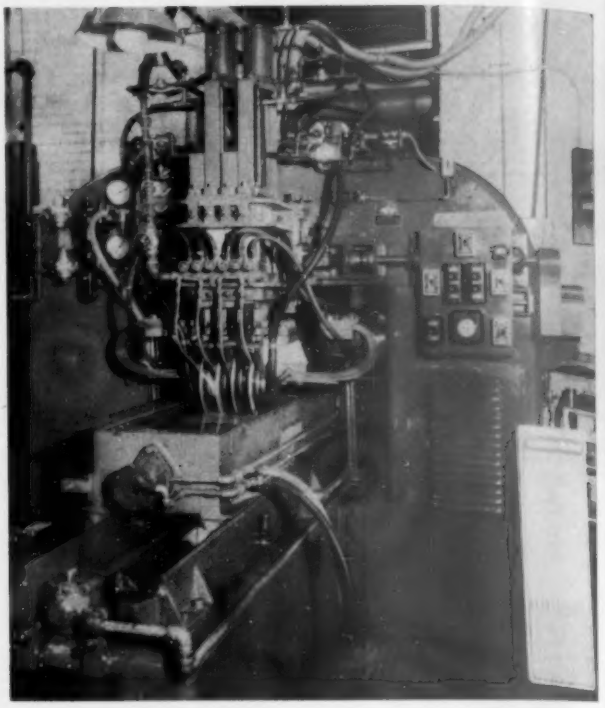

Fig. 5—A high production seam welding setup using 4 rolls for intermittent seam welding of stainless steel evaporator used on G.E. refrigerator. Welded under water for quick dissipation of heat.

minus .005 in. tolerance, and the height within a plus .005 in. minus .000 in. tolerance.

The writer has found from experience that a rigid tolerance on projection size is absolutely necessary for successful projection. Too many times,

Fig. 4—Welding a gas-tight seam around outside edge of G.E. refrigerator evaporator.

the effect of current density is completely disregarded, when specifying the size and type of projection necessary to give the required strength at the welded section of an assembly.

Figure 2 illustrates a welding machine used for welding a valve body to the compressor shell. (The compressor shell is the same one shown in Fig. 1, and is made of a low carbon deep-drawing steel). The valve body is a free-turning screw-machine stock, and is welded to the shell by the annular projection method. This particular type of weld is absolutely a gas- and vacuum-tight joint. The test required, is a piece of metal, the diameter of the annular projection, pulled completely out of the shell. The shell is of .094 in. stock, and the test is an hourly occurrence. This annular projection is held within a tolerance of plus .005 in. minus .005 in. in height, and a reject is practically unknown. The welding current is controlled by a synchronous thyratron control which assures no current transient variations and accurate timing.

Throughout the course of one year's production, approximately 1250 tons of stainless steel and 12,500 tons of low-carbon steel is used. After various parts have been formed from this material, they are thoroughly cleaned before going through the welding machines. It has been found that clean material increases the life of the electrodes and helps to consistently produce sound welds.

Spot, projection or seam welding the 18-8 variety of stainless steels, calls for considerable attention with regard to carbide precipitation in the weld, which of course ruins the stainless properties of the steel. Extreme careful attention is required when setting up a welder for this work, and all machines used for welding stainless

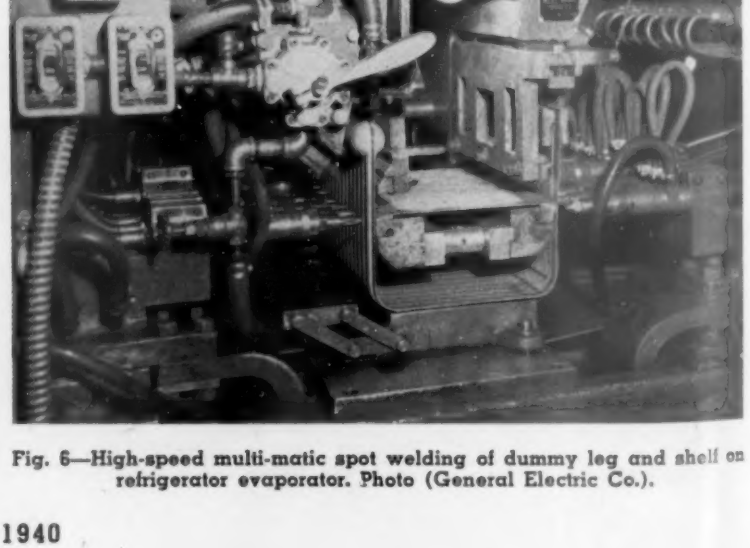

Fig. 6—High-speed multi-matic spot welding of dummy leg and shelf on refrigerator evaporator. Photo (General Electric Co.).

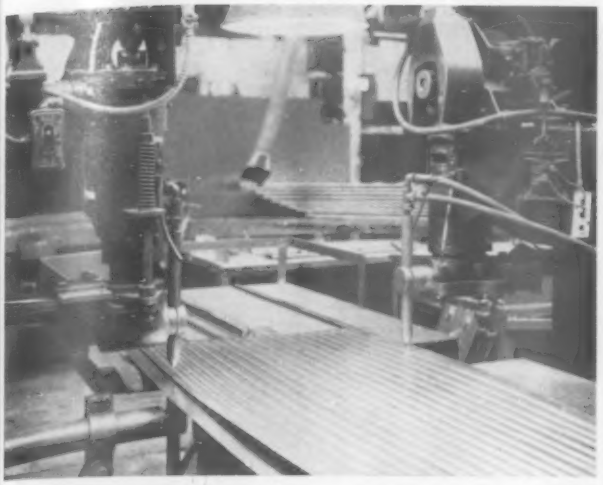

Fig. 7—Assembly spot welding of two mild steel condenser sheets. Photo (General Electric Co.).

steel are equipped with synchronous thyratron control. The welding transformers of all machines discussed in this paper are water cooled.

Figure 3 illustrates the type of machine used for assembly spot welding the stainless steel evaporator. This is a 20-kva. press welder, operating at 180 strokes per min. The two parts being welded are each .025 in. thick.

Figure 4 shows a conventional 60-kva. seam welder, which is used for welding a solid seam around the outside edge of the evaporator. This gas tight weld is made at 72 in. per min., is 90 in. in length and the ends of the weld are overlapped one inch.

Intermittent seam welding of this stainless steel product is done on a special 300-kva.platen type, multi-roll seam-welder, as shown in Fig. 5. This is a two transformer machine, each transformer being rated 150 kva. There are four rolls on this seam welder; one transformer secondary is connected to two rolls, making a series circuit, completed through the work and platen. The machine table is hydraulically driven, and air is used to apply pressure on the seam welding rolls. The platen is a solid copper body in which Trodoloy No. 1 splines (or backing-up bars) are inserted. These splines can be easily replaced when necessary. Several various types of platens are carried on hand, and are readily interchanged, depending on the size of evaporator being manufactured.

High-speed multimatic spot welding has increased the efficiency of manufacturing a great deal. Figure 6 illustrates a machine with two transformers, each rated 75 kva. with one common secondary terminal. Hydraulic-type gun-operated electrodes are used. There are 16 spot welds to be made, eight on each side of an evaporator. On one side, the evaporator shelf is welded in place, and on the other side a dummy leg is welded to the evaporator. The sequence of operation and firing of these 16 electrodes, is as follows: No. 1 on dummy leg side, No. 2 on shelf side, No. 3 on dummy leg side, No. 4 on shelf side, etc., until 16 welds are made. This sequence of operations was developed, to prevent distortion of parts being welded.

The electrodes used on this job, and all other stainless steel welding machines, are made of an alloy known as Trodoloy No. 1.

Figure 7 illustrates the spot welding of two condenser sheets, making one complete part to be handled on the following seam weldin operations. The spot welders are each rated 60 kva. and the mechanical tripping device on each machine was changed to an electrical solenoid operation. The solenoids have 110-volt a-c. coils and are wired in parallel to one foot-operated switch, permitting both machines to be tripped simultaneously, thereby producing two welds at the same time on each side of the condenser. The distance between electrodes is 23 in.

Seam welding the refrigerator condenser is done on a special 300-kva. platen-type, multi-roll seam-welder as shown in Fig. 8. Construction of this machine is somewhat similar to the one shown in Fig. 5. (The platen is a solid copper body, in which cadmium-copper splines are inserted. It is necessary to use this type of spline, because it is essential to use a higher conductivity electrode when seam welding low-carbon steel sheets. This differs from welding stainless steel, as shown in Fig. 5, where a lower conductivity electrode can be used. The seam weld is gas tight, and the material is thoroughly cleaned before entering the welding machines. All welding on this platen-type machine is done under water. The water is cooled and recirculated. During the summer months, when the ambient temperature is highest, the water temperature averages about 90 deg. F. This water cooling not only improves the welding, but also protects the machine operator, if a piece of laminated stock gets into the welding machine and flashes. Also, on this type of machine the secondary shunt connections are water cooled.

(*To be continued next month*)

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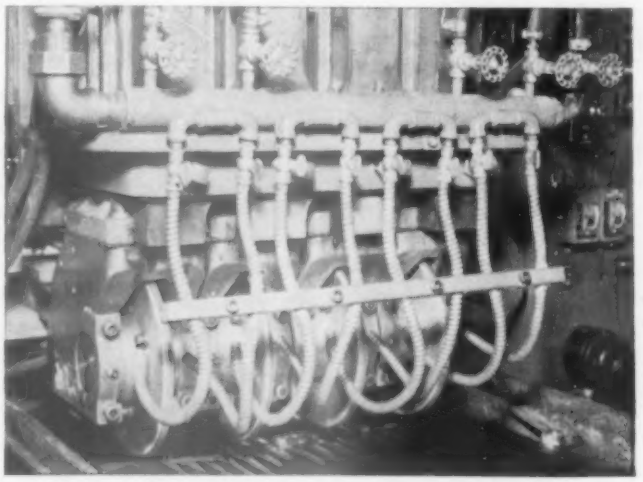
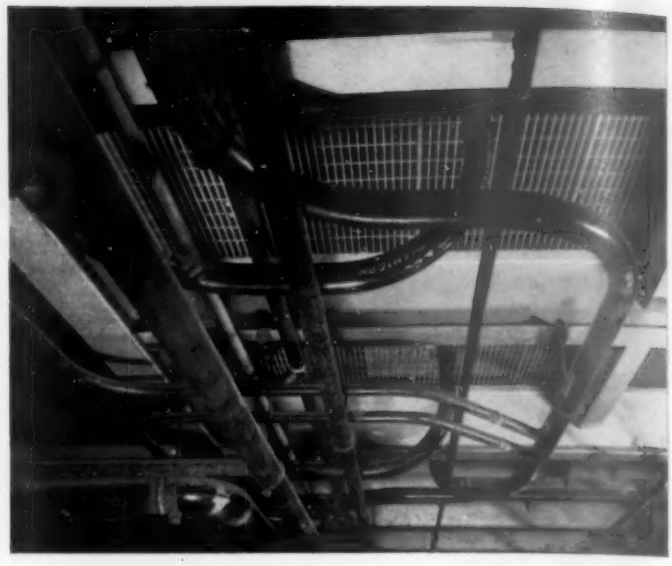


Fig. 8 — Four-roll, platen type, full automatic control seam welder used for continuous seam welding of low carbon sheet steel condenser.



Here is a neatly executed job of pipe welding in the new municipal electric power plant for the City of Holland, Mich. Photo (Crane Co.).

Oxy-Acetylene Welding of Carbon-Molybdenum Pipe

★ A summary of results of numerous field tests of "carbon-moly" welding rods and pipe welding procedure — New process specification is submitted.

By ARTHUR N. KUGLER*
Mechanical Engineer, Applied Engineering Dept., Air Reduction Sales Co., New York City.

CARBON-MOLYBDENUM steel piping is employed under practically the severest operating conditions now existent for power piping. It should therefore be obvious that this steel requires the highest quality of welding. Virtually all of this type of piping installed to date has been arc welded with carbon-molybdenum electrodes. The only exception to this has been on superheater tubes. The quality of this welding has been entirely satisfactory. Contrary to the common conception oxy-acetylene pipe welding is no slower and no more costly than equivalent competitive processes. Data collected by a large eastern utility company on the welding of heavy wall plain carbon steel pipe indicates that oxy-acetylene welding is performed in one-third to one-half the time required by other standard procedures. The greater difference in production occurs in general in the small sizes and lighter weights, while lesser differences occur in the larger diameters and greater wall thicknesses. The range covered by this study is from 4 in. by 0.531 in. wall to 18 in. by 1.75 in. wall.

It was with full realization of the requirements of this field and the inherent advantages of the oxy-acetylene process that we undertook the field testing of carbon-molybdenum gas welding rods and the attendant welding procedure. In general, the function of field tests is to apply the laboratory's findings on actual construction or under field conditions to determine, first, whether the laboratory results can be duplicated, and, second, whether any changes or modifications are necessary to render the operation practicable and economical for industry. This field work has involved tests or actual applications at some twenty different points representing piping fabricators, power companies, industrial power plants, boiler fabricators and other allied industries. While results from all of these tests are not available at this writing, sufficient data are on hand to permit us to state that our work confirms the findings of the research laboratory. Only minor

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modifications have been necessary to adjust the procedure to field conditions.

In these field tests we have welded carbon-molybdenum steel pipe ranging from 3 in. by 0.4375 in. wall up to 14 in. by 0.875 in. wall. These welds have been submitted to practically all of the standard tests including those required under the American Standards Association Code for Pressure Piping. It should be realized that where the laboratory welds are entirely made in the rolling position, the field tests are made in all positions, viz., fixed horizontal position, fixed vertical position and roll welds. These field results may therefore be taken as representative of what may be expected in actual construction.

Since current code requirements indicate the stress-relieving of carbon-molybdenum steel welds, all of the following results are taken on specimens which have had the benefit of this treatment. Practically all of the specimens have been stress-relieved by means of the oxy-acetylene torch, heating the joint to 1400-1500 deg. F. and immediately wrapping and otherwise providing for slow cooling. It is interesting to note that included in the field test results are the figures for two welds made by shop operators under the identical conditions required for qualification test welds.

The open single-vee butt joint without backing up strip or liner has been used almost exclusively. The bevel preparation comprehended 30 to 37½ deg. bevel angles, with or without the usual land depending on whether the joints were prepared by machine tool beveling or machine torch cutting. The multi-layer welding technique has been employed exclusively with but the one slight modification of thinner layers. On rolling welds it has been found entirely acceptable to employ layers as thick as $\frac{3}{16}$ in. On position welds it has been found desirable under some adverse conditions to resort to layers as thin as $\frac{5}{32}$ in. Continuous deposition of layers is preferable in this welding.

The following rod sizes have been found to be desirable for the various thicknesses welded under the given conditions: for rolling welds the first layer should be made with the ⅛ in. diameter rod and the intermediate layers up to ¾ in. thickness with $\frac{3}{16}$ in. rods; intermediate layers above ¾ in. thickness should be made with ¼ in. rods and the final layer is best made with the ¼ in. rod. On position welds the first layer should be made with ⅛ in. rods and the intermediate and final layers with $\frac{3}{16}$ in. rods.

One further factor merits attention in the oxy-acetylene welding procedure. Separate preheating of carbon-molybdenum steel for oxy-acetylene welding is not necessary. The inherent preheat available in the oxy-acetylene flame has been found to be entirely adequate for the majority of joints to date. In the heavier wall thicknesses it sometimes proves advantageous on the first few layers to alternately preheat and weld with the torch. Separate preheating may be desirable under some circumstances especially in shop fabrication to expedite the work. It should be remembered, however, that a separate source of preheat is not essential and therefore should not be required by a process specification.

Results of physical tests have been summarized in Table I. It will be readily seen that the reduced-section tensile test figures indicate full compliance with code requirements. The welds develop an ultimate tensile strength equal to or exceeding that of the base metal which is all that is necessary. Since the longitudinal all-weld-metal tensile test specimen is not generally employed in the field for process or operator qualification little attempt has been made to include this in the field tests.

Mr. Kugler's paper summarizes the results of almost 20 field tests of carbon-molybdenum gas welding rods and the attendant welding procedure. Results of tensile, free bend, restricted bend and nick-break tests are tabulated, indicating that current requirements are readily exceeded by welds made in this manner. Data is also provided on impact values and hardness readings on both weld metal and heat-affected areas.

A process specification for oxy-acetylene fusion welding of carbon-molybdenum steel pressure pipe lines is presented, including such matters as required base metal, welding rod, bevel preparation, and size of welding tip.

The value of stress relieving is discussed and the recommended methods are described, including a recently developed technique designated as "short time stress relief." Results of such post-heating are shown to be in conformance with present requirements.

Table I—Physical Properties of Test Specimens

REDUCED SECTION TENSILE TEST	
Ultimate Tensile Strength	
	63000 psi. avg. (61000-65750)
	42000 psi. avg. (40800-44970)
Yield Point	
	All Failures Outside Weld
FREE BEND TEST	
Average Elongation	46% avg. (40-51)
NICK-BREAK TEST	
	Silky Fractures—Fine to Very Fine Grain—Slight Porosity Occasionally
BACK-BEND TEST	
	Bent 180 deg.—Only One Specimen Bent Less (140 deg.)
SIDE-BEND TEST	
	Test Made on ⅜ in. Thick Specimens in Restricted Bend Test Jig—Bent 180 deg.
RESTRICTED (GUIDED) BEND TEST	
	All Specimens Tested Readily Bent 180 deg. on Both Face and Root Bends

The next logical tests made in the field investigation were the various bend tests, including free-bend, restricted-bend (both face and root) and side-bend. It should be appreciated that these tests are really qualitative and more indicative of the operator's ability rather than determining specific physical constants. Table I shows that the free-bend elongation ranges from 40-50% which is entirely adequate and well above the minimum. The guided-bend test, which is more severe than the old free-bend test, shows further that these welds are possessed of a high degree of ductility. The side-bend test, made in the restricted-bend test jig, further emphasizes this fact.

The nick-break test has been included in this work for the reason that it is still part of the requirements of the American Standards Association Code for Pressure Piping, edition of 1935, which edition is still in force although shortly to be superseded by a later one. The nick-break test has perhaps come into disrepute recently due to the inability of some inspectors to interpret the fractures. This fact should not permit us to entirely disregard this test, because it still

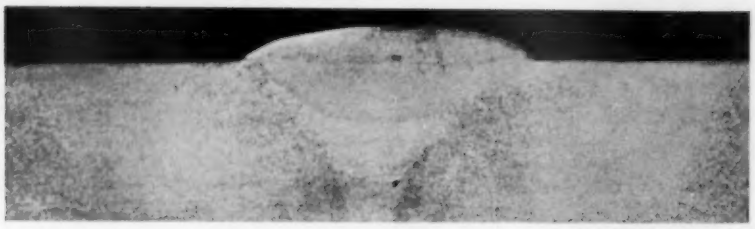


Fig. 1—Macrograph of weld cross section. Note that variations in grain structure in the different zones is clearly defined.

Fig. 2—Some of the test specimens made in checking process procedure on "carbon-moly" pipe welding.

possesses the merits of simplicity and ready application. The nick-break test still provides an intelligent inspector with a wealth of information. It is interesting to note that on all of the specimens examined in the field a very fine grain structure was evident with a minimum of defects. Uniformly good fusion throughout the weld cross section is found.

Other additional tests have been included in this field investigation for the purpose of developing further the average properties of these welds. Among these have been chemical analysis of deposited metal. It should be realized that the analysis of the pipe metal will have a marked influence upon the deposited metal analyses. Any variations which exist are doubtless due to this fact since the welds were on pipe from many sources.

Table II—Chemical Analysis of Deposited Metal

Test	C	Mn	P	S	Si	Mo
A	0.09	—*	—*	—*	—*	0.65
B	0.10	0.60	0.021	0.010	0.03	0.68

*Not taken on this test

The weld metal density was checked at one point of test and found to be 7.83. This exceeds the minimum value prescribed and is therefore entirely acceptable.

A hardness exploration conducted on the base metal, heat-affected zones and deposited metal indicate that the maximum is well below 200 B.H.N. In Fig. 1 is shown a photograph of weld cross section magnified approximately two times. The variations in grain structure in the different zones is clearly defined. One slight inclusion is evident in the first layer. This illustration shows clearly the benefits derived in grain refinement by multi-layer welding.

In addition to these field tests, one small installation has been completed in the middle-west. This system operates at 1800 psi. and 900 deg. F. and involves the following sizes of pipe: 2 in. by 0.438 in., 3 in. by 0.563 in. and 4 in. by 0.674 in. This piping has been installed for service to a group of heaters. Multi-layer welding employing three layers of weld metal was used on all three sizes of pipe. The work was performed under the usual field difficulties and involved all of the usual types of joints. Stress-relieving was accomplished with oxy-acetylene torches heating the joints uniformly to a temperature of 1400-1450 deg. F. and immediately upon reaching that temperature the joints were covered with asbestos blankets or paper and plugging any open ends. The stress-relieving temperature was checked with a pyrometer. This project was installed by the owner's forces and no attempt was made to rush the job. The following interesting production data were obtained during course of construction:

3 in. position weld 50 min. plus 5 min. for stress relief
3 in. rolling weld 40 min. plus 5 min. for stress relief
2 in. position weld 40 min. plus 4 min. for stress relief
2 in. rolling weld 30 min. plus 3 min. for stress relief

The daily production rate averaged eight 3 in. or ten 2 in. welds. Under test conditions and in approximately one year's operation no leaks or failures of any nature have developed.

Additional data, although admittedly incomplete has been reported from several points. An 8-in. 0.625 in. wall carbon-moly pipe was welded in 1½ hours (roll weld) and stress-relieved at 1400-1450 deg. F. in 17 min. with two torches. This joint required 80 cu. ft. of oxygen, 70 cu. ft. of acetylene and 2.75 lb. of rod. Post heating consumed 45 cu. ft. oxygen and 38 cu. ft. acetylene. Other reported data include 2¼ hrs. for welding 10⅝ in. by 0.718 in. wall pipe and 3 hours for 14 in. by 0.75 in. wall pipe. It should be appreciated that this information is insufficient as a basis for estimating purposes.

One further practical application is in process of development at the present moment. A large fabricator of superheaters is training his shop force for the welding of superheater tubes with this welding rod. It is planned to use this process and rod on the fabrication of a large superheater unit.

Based upon these field tests and applications we have prepared a "Process Specification for Oxy-acetylene Fusion Welding of Carbon-Molybdenum Steel Pressure Pipe Lines":

Process Specification for Oxy-acetylene Fusion Welding of Carbon-Molybdenum Steel Pressure Pipe Lines

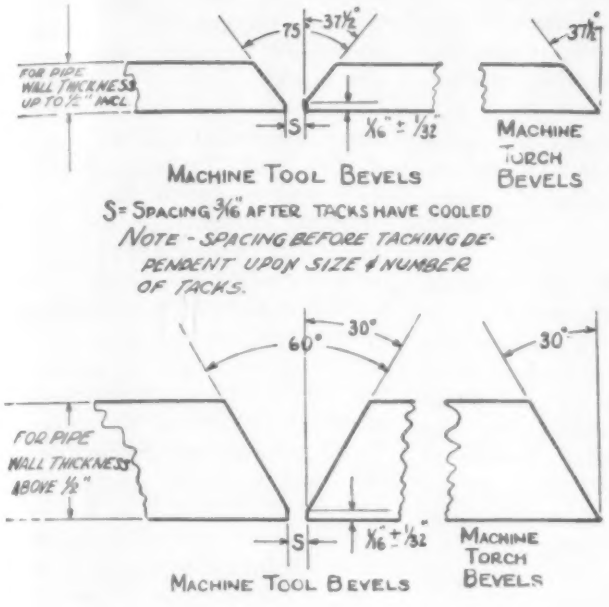
Base Material: The base metal shall conform to A.S.T.M. specification A206-38T.

Process: The welding shall be performed by the oxy-acetylene process.

Filler Metal: The filler metal shall be carbon-molybdenum oxy-acetylene welding rod.

Welding Groove: The welding groove shall conform to details as shown in Drawing No. 1 (See Fig. 3). The same welding groove shall be used for vertical and horizontal pipe welds. When it becomes necessary to bevel pipe in the field, machine guided oxy-acetylene

PIPE WELDING PROCESS SPECIFICATION



DWG. #1
BEVEL PREPARATION

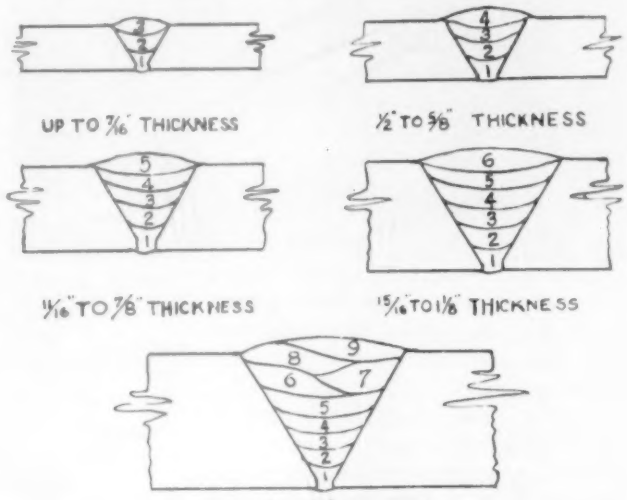
Fig. 3—Details of pipe welding groove, prepared either by machining or by flame-cutting.

Schedule No. 1—Size of Welding Tip

Pipe Wall Thickness	Use Tips Consuming Acetylene—Cu. Ft. Per Hr. (Approx.)
⅛ in.—¼ in.	12—36
⅜ in.—½ in.	36—60
⅝ in.—⅞ in.	30—100
⅞ in.—1⅛ in.	50—175
1¼ in.—2 in.	65—175

NOTE: In general, larger tips of a range (greater acetylene flows) will be used for rolling welds, while smaller tips (lesser acetylene flows) will be used for position welds.

PIPE WELDING PROCESS SPECIFICATION



ROD SIZES FOR LAYERS

WALL THICK.	ROLL WELDS 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	POSITION WELDS 1st	OTHERS
7/16	1/8"	3/16"	1/4"							1/8"	3/16"
5/8"	1/8"	3/16"	3/16"	1/4"						1/8"	3/16"
7/8"	1/8"	3/16"	3/16"	5/16"	1/4"					1/8"	3/16"
1⅛"	1/8"	3/16"	3/16"	3/16"	1/4"	1/4"				1/8"	3/16"
1⅜"	1/8"	3/16"	3/16"	3/16"	1/4"	1/4"	1/4"	1/4"	1/4"	1/8"	3/16"

DWG #2
DEPOSITION OF LAYERS

torches shall be used. It shall not be necessary to provide a land or shoulder on these joints.

Cleaning of Welding Groove: Prior to welding, the edges of pipes and surfaces adjacent thereto shall be thoroughly cleaned of all scale, rust, grease or oil. A thin film of linseed oil will be permitted for preservation of machine tool beveled surfaces.

Welding Equipment: Welding torches of an approved type shall be used. Sizes of welding tips to be employed shall be as shown in Schedule No. 1.

Nature of Flame: The flame used for welding shall be neutral ranging to a slight excess of acetylene.

Method of Welding: The method of welding shall be "forehand" or "backhand" as the position of work indicates most expedient. **Definitions:** Forehand welding is that method of welding in which the torch flame and welding rod are so disposed that the flame points ahead in the direction of welding and the rod precedes the flame.

Backhand welding is that method of welding in which the torch flame and welding rod are so disposed that the flame points back at the completed weld and envelopes the molten puddle, and the rod is interposed between flame and puddle.

Number of Layers and Method of Deposition: The number of layers of weld metal shall be as shown in Drawing No. 2 (See Fig. 4). The size of welding rods to be used shall be substantially as indicated in Drawing No. 2.

Fig. 4 — Suggested number of layers of weld metal. Also recommended sizes of gas welding rod.

For horizontal pipe rolling welds and for vertical pipe position welds, each layer shall be deposited in a continuous circuit of the pipe. When vertical pipe position welds are in difficult positions, the method of deposition of layers may be varied but shall conform substantially to that given below for horizontal pipe position welds.

For horizontal pipe position welds each layer shall be started at the top center line and progress downward to the bottom center line. It shall then be restarted (exercising proper precautions to insure fusion at this point) at the top center line and progress downward, on opposite side, to bottom center line where it meets and is fused with previous deposit.

Cleaning of Weld: Each layer shall be wire brushed for removal of loose scale before laying down next successive layer of welding.

Pipe Stress-Relieving

The question of stress-relieving is one which cannot be ignored in any consideration of carbon-molybdenum steel welding, since it is generally recommended by the manufacturers of pipe material. Standard procedures employed under present fabricating conditions usually require stress relief at temperatures of 1100-1200 deg. F. and maintenance of this temperature for varying periods, from one hour to four hours per inch of thickness. Electric resistance and induction heating methods have been extensively employed. Investigation has disclosed that other methods of heat application will yield equally satisfactory stress relief.

Current code requirements require heating to 1100-1200 deg. F. for at least one hour per inch of thickness. This may be accomplished with an oxy-acetylene torch or torches, depending on size and thickness of the joint. From an economical standpoint, however, this is practical only with a relatively small number of joints as usually encountered in the field. In an extensive field operation it has been found more practical to employ burners equipped to use low temperature fuel gas and compressed air. A different size burner is required for each size of pipe.

Stress-relieving with gas flames permits of tapering off the heat affected zone so as to avoid any sharp difference between stress-relieved and non-stress relieved areas. Temperature control is obtained through use of pyrometers, the most common in use now being the contact type. If necessary temperature recording instruments and thermostatic control can also be installed.

Still another method of stress relief which offers much promise has been employed to a limited extent. For want of a better name it has been designated as "short time stress relief" to distinguish it from the other methods. In this procedure after the weld has cooled to say 600 deg. F., the pipe weld and the necessary zone of adjacent base metal is heated uniformly with one or more torches to a temperature range of 1400-1500 deg. F. This is the closest approach to ideal annealing conditions obtainable in field work. When this temperature is reached as determined by pyrometers, the joint is immediately wrapped with asbestos paper or blankets and any opening plugged up to eliminate interior drafts. This provides slow cooling.

Tests have shown that temperature difference between the outside and inside of a pipe will be about 50 deg. F. but never any greater than 100 deg. F. By utilizing two or more torches, depending on size and thickness, equipped with multiple-flame tips, if necessary, it is possible to achieve a very uniform heating. This method was first used on a plain carbon steel piping system on both shop and field welding and tests of joints treated in this manner showed greatly refined grain structure and high ductilities when subjected to bending. All but one of the field tests included in the summaries given above were stress-relieved by this method and the results by present standard practices were no better than those by short time stress relief. All tests conducted to date indicate that this method produces entirely acceptable results.

There has been much discussion of late as to the benefits to be derived from stress-relieving, some engineers having gone as far as saying it is not at all necessary. It is not the intention to take sides in this controversy, but rather to indicate that a simpler, less expensive means is available in short time stress relief. Since the only practical means of determining the value of these heat treatment methods is by investigation of the grain structures of welds and measurement of ductility, either by bending or in tensile tests, it is submitted that short time stress relief meets the requirements now demanded of other procedures.

Independent tests of the relative costs of stress-relieving by the various methods indicate that heating with either the oxy-acetylene torch or low temperature fuel gas and air flames is slightly less costly than the other standard methods. Short time stress relief is appreciably cheaper than any of the methods noted. Added to this are the advantages of portability and flexibility of the equipment plus the fact that oxygen and acetylene are invariably available on construction work.

On the basis of this work we can now recommend the oxy-acetylene welding of carbon-molybdenum steel pipe in any of the sizes and weights currently employed in power plant practice. The requisites for successful application are; first, a welding rod of the carbon-molybdenum analysis designed for oxy-acetylene welding; and second, the use of the multi-layer welding technique modified as indicated. Third, the employment of stress relief by any of the methods mentioned.

The writer wishes gratefully to acknowledge the co-operation of Eric R. Seabloom, research engineer of Crane Co., Chicago, P. T. Onderdonk and E. J. Wiseman of the Consolidated Edison Co., New York City, and, R. R. Stuart of National Valve and Manufacturing Co., in conducting field tests and making available much of the data used herein.

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Using a portable grinder on a stainless steel welded tank. Photo (Black & Decker Mfg. Co.).

Are you spending
too much time and effort

On Cleaning Your Welds?

By ROBERT LATTICE

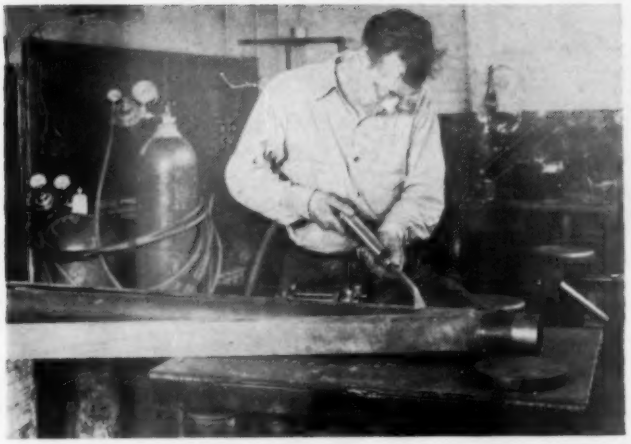
ARC WELDING HAS come a long way from welding as an art to welding as a science. Yet one fundamental point in welding has been overemphasized to a tremendous extent, namely cleaning. Ever since the days of welding as an art, welding operators have been the sole judge of the amount of cleaning required to make a good weld. As a result more good dollars are wasted on this phase of welding labor than on any other. It is about time that more light be focused on this wasteful practice, in an effort to accomplish economy of effort more in line with recent welding developments.

Most of the wasteful cleaning effort is expended in multi-pass welding in order to meet the requirements of codes and x-ray inspection. Here polishing and wire-brushing for hour after hour, along with much needless chipping, is substituted for good welding procedure. In those instances where basic procedure is adequate weld cleaning is largely done as an additional gesture toward quality.

That cleaning is necessary prior to welding in some cases is a well established fact. Particularly should oily surfaces be cleaned prior to welding. One of the best ways of accomplishing such cleaning in the shop is to provide a tank containing a proper cleaning chemical. The usual arrangement is a combination cleaning and rinsing tank, although some shops prefer a steam gun into which is injected the cleaning compound. Either method will remove the oil and prepare the parts for welding. This procedure is especially recommended for removing cutting oils that result from preparation of welding grooves, drilling of tube sheets in heat exchangers and cutting and threading of couplings that must later be welded.

Although some cleaning compounds will remove both paint and rust satisfactorily, there are other methods more adapted to this work. Sand-blasting and the newer flame-descaling are both suited to this service. Choice of either procedure depends somewhat on the locality in which the work is performed and somewhat on the existing shop equipment. Then there is the wire brush operated either manually or driven by air or an electric motor. For removal of rust or paint along the line of weld, the wire brush has proven itself to be an indispensable tool. Properly used the power or labor costs are not excessive and improvement of weld quality is readily noticeable.

Flame-cut edges next deserve mention. Surely no one doubts the fact that a properly cut edge may be welded without further preparation. Sometimes welding engineers and inexperienced designers specify the grinding of flame-cut edges before welding. But, unless the cut is jagged, there is no need for further work after the flame cut has been made. In those instances



Using a light weight pneumatic chipping hammer to remove weld splatter on a U-bar jack cylinder for a wagon drill. Photo (Cleveland Pneumatic Tool Co.).

where a recessed spot has been made by improper cutting manipulation, chipping or grinding to achieve a smooth contour must be done. Otherwise a bad spot inviting the inclusion of slag during welding will exist.

How Much Cleaning Needed?

Now for a consideration of the amount of cleaning necessary to attain a proper multi-pass weld. A welder spends his time welding, cleaning and setting-up. An analysis of any welding operation on any weldment may be made involving these three factors. For the sake of simplicity, setting of the machine and other miscellaneous operations have been grouped under the same heading, "setting-up." How much time does the operator spend performing each of these separate functions?

First, consider welding. How much time does the operator spend welding? What per cent of his total time is spent in arc manipulation? If you don't know the answer to that question, you can't know your welding costs. You can't know whether your welding operations are efficient or inefficient. Depending upon the size of the job, jigging and other variables which change from shop to shop, this time will range from 20% to 80% of the welder's time. On small work involving much set-up time, the welder may be doing the type of skilled work for which you are paying him, only 20% of the total time. On large work involving little set-up time, with a large amount of welding to be done after the set-up is made, the welder may be welding as much as 50% of the time. And 50% arc time represents a high operating factor. Seldom does manual operation approach this figure, except on quite heavy multi-pass welds.

Next, consider cleaning. What per cent of his total time is spent in cleaning? The answer in the average shop varies from 20% to well over 50%. Impossible! No, on the contrary, it is quite probable. As soon as you finish reading this article, check your stop watch against your pocket watch and see what the situation is in your shop. If the welder is cleaning his own work and producing welds of the highest quality, by cleaning 20% or less of the time that he is working, your shop is in fine condition and your worries are over, as far as the cleaning problem is concerned. And in almost direct proportion to the amount of time over 20% that is spent in cleaning, are savings made possible by studying this phase of the welding problem.

In the first place the welding operator must have enough skill to make a weld in the flat position with a heavily-coated electrode that will wash up well on the side walls of the groove without undercut. Almost any one of a number of electrodes will do that in the hands of a skilled welder. When such a weld is made in a groove, the operator need only crack out the slag with a pneumatic tool and blow out the broken slag before depositing the next pass. In the event that the thickness of the weld necessitates peening, a mild peening operation should follow. But don't wire brush the seam! Wire brushing has its proper place. We've already taken care of all the wire brushing that is required under the heading of "preparation for welding." Any slag that can be removed by a wire brush will be floated out by the hot welding arc when it deposits the next pass. Remember that and you will effect a reduction in labor costs.

Using a portable electric sander to smooth a weld in a stainless steel tank. Photo (Black & Decker Mfg. Co.).

Chip Out "Undercuts"

Sometimes, even in the very best welding shops and by the very best welding operators, an undercut will appear along a side wall. Usually this undercut is caused by slag running ahead of the arc. Such an undercut, or "bughole" if you prefer that term, must be chipped out smoothly. We are going to save money by reducing the amount of cleaning that we do, but we are not going to sacrifice the weld by inadequate cleaning. Undercuts don't burn out. Sometimes welders think they can burn out an undercut but it can't be done. Chip back into an undercut that has apparently been burned or melted out and see the dust fly when you hit the hidden pockets. Undercuts may be covered over but they can't be melted out. Another cause of undercutting is magnetic interference with the arc. Still another cause is improper arc manipulation. But whatever the cause, all undercuts must be chipped out.

Welding operators apparently like to use chipping and peening tools. Yes, it's a fact, even though the average welding operator will swear up and down that he doesn't like to use a chipping gun. How else can you explain the vast amount of unnecessary chipping and peening done by the average welder? Maybe it's just ignorance, due to lack of proper instruction. Rather than use a simple starting arc motion requiring a second or two of concentration, the average welder will spend five minutes chipping off the resulting hump. Unless the welder is working under a piecework plan, you pay twice for that misplaced metal—once for putting it in and once for chipping it out. If the welder is working under a piecework plan, you both

lose. Poor welding starts cause unnecessary cleaning.

Just as poor starts cause excessive cleaning, so do poor stops. There are several correct ways of breaking an arc. Any one of them is to be preferred to the one that leaves a "bughole" or pinhole in the crater. When you find such a defect, chip it out. But better still show your welders how to avoid such errors.

Even though a brief mention of peening has already been made, some further discussion is in order. How much peening is needed? To answer this, make a test plate of the same thickness as the joint you propose to weld and see how much peening is necessary to keep the plate flat. Roughly a plate warps 1 deg. for each pass. The American Welding Society, in one of their specifications, allows a warpage of 5 deg.—no more. A thickness of ⅛ in. of weld metal per pass is said to be good practice in manual multi-pass welding. All right, there's a starter. If you are using a single vee and putting five passes in a ⅝ in. thick joint, don't peen. Perhaps even a 1¼ in. double-vee weld doesn't need peening. However, design and permissible distortion enter the picture. Suit the peening to your needs. Make it adequate but don't pay for any more peening than you need.

Don't Overpeen!

Don't overpeen! More harm can be done to weld metal by overpeening than by underpeening. The technical literature is full of tests that show a marked loss of ductility where overpeening has been done. Find out how much peening you need. Instruct your welders definitely to peen lightly, or to peen moderately, or not to peen, as the case may be. When possible free them of this odious task so that they can do more welding for you. Do some research work and determine the minimum amount of peening that will suffice.

Next, what about plug welds, slot welds, pads and bosses? Here is another fruitful field for the fellow who likes to polish with a wire brush or pick with a slag hammer. Polishing or picking is hard work, harder than welding, in fact. Let's discover how to do this type of work and forget the cleaning.

Plug and slot welds should be welded at the periphery first and then the arc should be carried along towards the

Using a motor-driven buffing wheel to polish welds in a stainless steel tank. Photo (Black & Decker Mfg. Co.).

center of the hole. With practice a welder can maintain a good molten pool and do a satisfactory job of burning two or three electrodes in succession. Then the accumulated slag can be removed. This small amount of cleaning is predicated on the fact that no more than a second or two is required to change electrodes. Should the slag become cold before the operator can change electrodes, then by all means clean off the slag before proceeding.

Pads vary somewhat according to size. Some pads may be built up by oscillating the electrode over the width of the pad, while others must be made by depositing relatively long stringer beads. In either event the amount of cleaning required will depend upon the properties of the electrode. For a mild steel pad, either a reverse-polarity or a straight-polarity electrode is usually used. For oscillating, the reverse-polarity electrode will make a nice pad with a minimum amount of cleaning. A large pad, on the other hand, is best suited to the straight-polarity type of electrode. In either case build up a complete layer before attempting to remove the slag. A little experimentation will enable the operator to complete an entire layer before slag removal is necessary.

Bosses have some of the characteristics of the slot or plug weld and some of the characteristics of the pad. Where a pipe is used for the frame of the boss, it is best to weld the entire periphery. Next clean off the slag. Then by oscillation deposit as heavy a layer as you can at a time. Allow the weld to cool before attempting to remove the slag. In this connection it is preferable to have a number of bosses to weld at the same time, so that the welder can be welding on one boss while another is cooling. If the welder is making but one boss, have him wait for the weld to cool. Let him rest. The overall cleaning time will be the same, and the welder won't wear himself out attempting to remove some sticky slag that wants to stay on the weld. For the slag does protect the weld from certain gases in the air while the weld is still quite hot.

Use Good Tools

About the same general rules apply to fillet welds made in either the vertical or horizontal position. Defects should be chipped out always. Slag should be allowed to cool before attempting to remove it. The use of a good light peening tool for slag removal is faster than the well-known and much-abused slag hammer. Since our main object is to reduce the cost of our welds by means of intelligent cleaning, the more expensive tools will more than pay for themselves.

At this point a word of caution might be in order. Whatever steps we take to reduce the overall costs of welds will mean more welding work for everyone. Eliminating unnecessary cleaning will do much to help the shop reduce its labor costs. Go slowly and check every step. Make tests.

One of the simplest and most revealing tests that can be made is the hot acid etch test. Take one part of muriatic (hydro-chloric) acid and one part of water and heat a weld section in the mixture for 20 min. at 160 deg. F. Brush off the scum and rinse in hot water. This simple test will reveal all weld faults and enable you to correct them. Use this and other simple tests as an aid in checking the amount of cleaning needed.

In case the reader is unfamiliar with the preparation of samples for hot acid etching, the pieces may be sawed or flame-cut and then finished on the shaper. Next, the surface should be ground to a smooth finish. Finally, all oil or grease must be removed and the samples should be preheated in hot water before transferring to the hot acid. A few simple Pyrex beakers will serve as acid containers in which to do the etching.

Most welded jobs must present a clean and finished appearance. Buckshot has its place but not alongside a

(*Continued on page 31*)

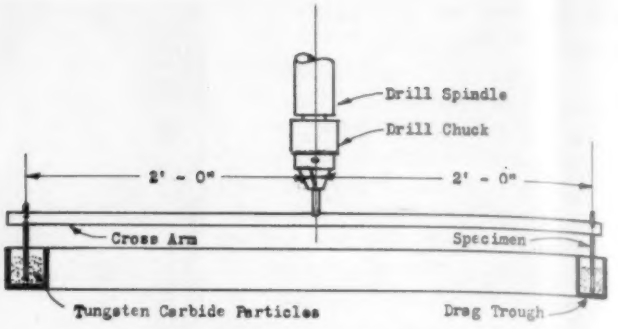


Fig. 25—Simple "wear" testing machine devised by the author.

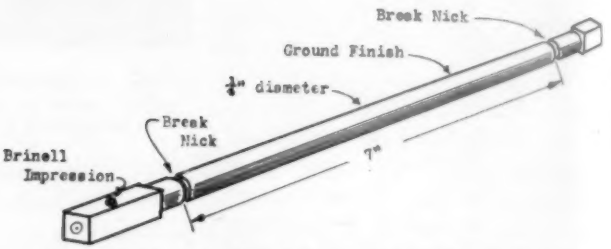


Fig. 26—An abrasion test specimen. Measurement of "wear" is based on loss of weight.

Analysis of

Fundamental Factors

Hard-Facing Technique

★ Part 6—Results of simple tests conducted to measure resistance to abrasive wear.

By T. B. JEFFERSON*

Engineer, Marine Design Section, Chief of Engineers, War Department, Washington, D. C.

"WILL THE HARDEST deposit wear the longest?" This and similar questions regarding the wear-resistant qualities, are asked most frequently when reference is made to hard-facing materials. But like so many questions involving hard-facing, they are exteremely difficult to answer. Likewise, it is equally as difficult to determine if the hardest material will have the longest wearing life.

There are many types of wear, as was shown in Part 1 of this series, and there has not been developed a standard test for determining the wear-resistant properties of metals. Consequently little is known with regards to the ability of a metal to resist wear.

In most applications hard-facing materials are used to retard abrasive wear. The characteristics of abrasive wear have been a subject of considerable study, and in an effort to arrive at a standard relationship between the Brinell number and a material's abrasion-resistant qualities, there have been developed a number of "wear" machines. Using these "wear" machines metals of known hardness were tested to determine their ability to resist abrasive wear. Examples of such machines are found in the designs of Saniter[5] for determining abrasion in rails, and Suzuki[6] in a study of resistance to wear of Swedish carbon steels. Both of these machines, as well as many others which have been studied, are elaborate in design and having been designed for a specific purpose were not readily adaptable for ascertaining the abrasion-resistant qualities of hard-facing materials.

Upon determining that the most reliable information regarding the resistance to abrasion of hard-facing materials would be obtained

*Part 5 of the author's series of hard-facing articles was published in April, 1940 issue, pages 29-32.

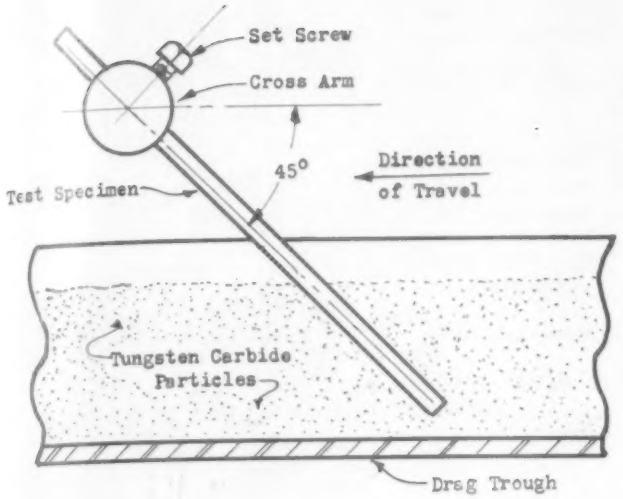


Fig. 27—How the test specimen was attached to the cross-arm. One specimen at each end of cross-arm.

only from a series of tests, a relatively simple "wear" machine was designed for these tests. The apparatus used is shown in Fig. 25. It consists primarily of three items: (1) A radial drill, (2) a cross arm for holding specimens, and (3) a drag trough containing tungsten carbide particles. The drill press serves as a means of motive power making possible the abrading of the test specimens which are affixed at the ends of the cross arm. During the test the specimens are dragged through the tungsten carbide particles and are thereby subjected to abrasive wear.

The abrasion test specimens were prepared from all-weld deposits of hard-facing materials. These specimens were ground finished, because of their hardness, to approximately .250 in. in diameter. The finished specimens were merely round rods of hard-facing material approximately 7 in. in length.

After the specimen was ground to size, a "nick-break" groove was ground in its circumference near one end. Approximately 7 in. from this groove, near the other end of the specimen, another groove was ground in the bar. The purpose of these grooves was to make it possible to break the unfinished ends from the specimen easily. When the grinding operations were completed, the Brinell number of the specimen was obtained. An abrasion test specimen at this stage of completion may be seen in Fig. 26.

The unfinished ends which assisted in holding the specimen during grinding were then removed. The ends of the specimen were ground off square, and after the specimen was given an identification number and weighed it was ready for testing. In a test of this nature extreme care must be exercised in obtaining the weights of the specimens, as the abrasion test is based solely upon the loss in weight of a specimen during test.

Abrasion tests were undertaken by affixing a specimen in each end of the cross arm (Fig. 27), each specimen of a different hardness. Each specimen was mounted at an angle of 45 deg. from horizontal, in the direction of travel, and so that the lower 3 in. of the specimen dragged in the tungsten-carbide particles.

When the weighed specimens had been so arranged the radial drill was started and the specimens were drawn through the tungsten-carbide particles until they had traveled 15,000 lineal ft. At this point they were removed from the machine and again weighed. The difference between original and final weight represented the loss by abrasive wear.

The tabulated results of this series of tests (Table 10) failed to establish a definite relationship between the Brinell hardness number of a material and its ability to resist abrasion.

In those materials in which the Brinell values were high there appeared to be much inconsistency with regards to their wear resisting qualities. These results confirm those of Stanton and Batson[7] who, in a series of tests designed to study the resistance to abrasion

Fig. 28—Two hard-faced plowshares. Lower one has worn slightly in plowing over 250 acres, but is still as sharp as the newly hard-faced share (upper).

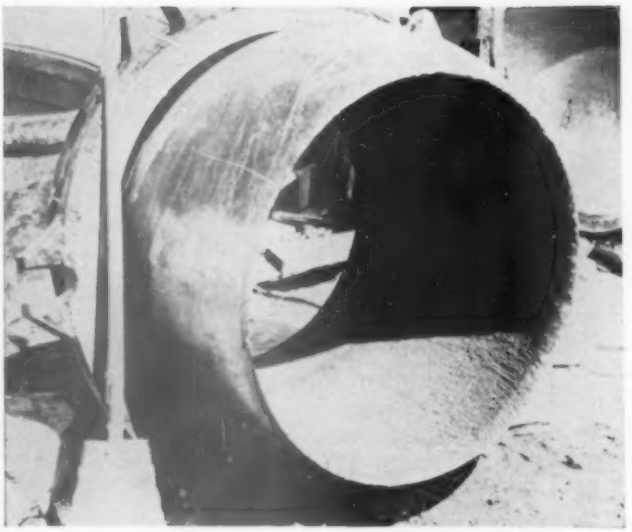


Fig. 29—The interior of this dredge pipeline ball joint is protected with a ferrous alloy hard-facing overlay.

Table 10—Relation Between Hardness and Abrasion Resistance.

Specimen No.	Type of Specimen	Brinell Number 3000 Kg. Load 10 mm. Ball*	Weight loss Milligrams	Diameter loss in Inches	Remarks:
901	Ferrous Alloy	555	20	.006	Very little wear
902	Non-Ferrous Alloy	477	23	.006	Very little wear
903	Ferrous Alloy	514	29	.005	Very little wear
904	Ferrous Alloy	555	37	.006	Very little wear
905	Non-Ferrous	444	104	.012	Noticeable wear on end
906	High Carbon	302	78	.008	Slight wear
907	High Carbon	302	100	.010	Noticeable wear on end
908	Mild Steel	201	196	.013	Considerable wear
909	High Carbon	302	204	.012	Considerable wear
910	Mild Steel	187	400	.016	Extreme wear

*Steel ball used in Brinell tests.

Note: This is a comparative test; two specimens are tested at the same time, one against the other. Specimens 901 and 902 made up one set, the other sets consisted of consecutive pairs of specimens.

for dry sliding friction, determined that: (1) There was very little correlation between wearing tests and Brinell numbers and (2) that Brinell tests were not reliable guides for predicting the relative resistance to wear of a miscellaneous assortment of steels. Likewise, Freeman[8] found that while alloys showed high hardness characteristics by some of the standard methods of testing, this fact did not necessarily give assurance that they had high wearing power.

These results and opinions, however, are contrary to those found for materials having low Brinell values. The results of the tests on Specimens 907 to 910 inclusive, indicate that there is a definite relation between the Brinell number and wear resistance. These results indicate that the higher the Brinell number of a material the greater its ability to resist abrasive wear. This is in accord with the findings of Suzuki[6] in his study of the relative abrasions between various heat-treated metal structures such as obtained in the annealed, sorbitic, troostic and martensitic structures. In these studies his results showed conclusively that the greater the hardness number, the less the abrasion effect.

The results of this series of tests were too limited and the variety of opinions too contradictory to reach definite conclusions. Before any tests of this nature will prove of value there are many factors which must be considered. For example, in determining the ability of a material to resist abrasive wear, it should be known whether the wear is the result of wet or dry abrasive action, whether it is straight abrasion, or if there are other destructive agents acting at the same time. In general, however, it might be concluded that: The most suited hard-facing material for a given situation may best be determined by past performance under similar operating conditions, i.e., a hard-facing overlay of specific hardness that has rendered satisfactory service in a given condition of wear will probably render equally as satisfactory service under similar conditions of wear.

A plow share is continually subjected to abrasive wear. Two plow shares are shown in Fig. 28 that have been protected with a diamond substitute hard-facing overlay. The lower share which has plowed over 250 acres, while worn, is still as sharp as the new (upper) share which has just received its overlay. Plow shares protected with the proper type of hard-facing material will not only out-wear an unprotected share 3 to 10 times,

Fig. 30—Large crusher roll for pulverizing coal. A ferrous alloy overlay is deposited at all points of wear (impact and abrasion).

depending on soil conditions, but they will also stay sharp and maintain proper suction.

Flexibility is maintained along a dredge pipeline by means of ball joints located between lengths of pipe at various intervals. The male half of this fitting (the ball) is subjected to wet abrasive wear coupled with erosion and corrosion—a particularly severe service condition. To retard this wear the interior of the ball is protected with a ferrous alloy hard-facing overlay as shown in Figure 29.

The large crusher roll pictured in Fig. 30 is used for pulverizing coal, along with an occasional spike or other metallic scrap included in the coal. In such service the

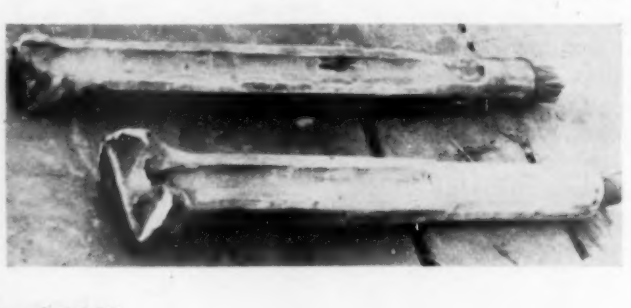


Fig. 31—Two cable drill bits which have been protected with an overlay of "diamond substitute" particles embedded in steel.

Literature references:

[6] E. H. Saniter 1908, A Test for Ascertaining Relative Wearing Properties of Rail Steel. Journal Iron and Steel Institute, Volume 78, pages 73-76. Discussion, pages 77-80.

[6] M. Suzuki 1927, Investigation of Abrasion in Carbon Steels. Journal Society of Mechanical Engineers. (Japan) Volume 30, pages 559-626. Also printed in English in Science Reports of Tohoku Imperial University, Series 1, Volume 17, 1928, pages 573-638.

[7] J. E. Stanton and R. G. Batson, 1916, Hardness Test Research. Report of Hardness Tests Research Committee. Proceedings Institution of Mechanical Engineers, pages 678-701.

[8] R. B. Freeman, 1937, The Relative Wear of Some Hard Metals. Metal Progress, Volume 31, pages 281-284.

rolls are subjected to impact as well as abrasive wear. For this reason rolls used for coal crushing are usually protected in such a manner as to retard wear by depositing a ferrous alloy hard-facing material at all points of wear.

In well drilling a cable drill bit is subjected to a combination of abrasive and impact wear. While subjected to this wear the nature of the work performed by the tool requires that it be extremely abrasive in its action. These conditions require that the hard-facing material which is to be applied to the chisel point and the reaming edge of the bit be highly abrasive in character and capable of withstanding abrasion and impact. Such a material is found in a hard-facing deposit in which diamond-substitute particles are embedded in an austenitic overlay. Two cable drill bits which have been protected by a hard-facing overlay are shown in Fig. 31.

In concluding this series of six articles on hard-facing technique it may be well to summerize the points which have been brought out by the various tests:

(1) Hard-facing materials deposited on surfaces which have been preheated will be harder than those made on cold base metal surfaces.

(2) Deposits of hard-facing made by either the oxy-acetylene or the metallic arc welding processes will exhibit higher hardness properties than those made by the carbon arc process.

(3) The metallic arc process is the most satisfactory from the standpoint of speed of deposition of metal.

(4) Hard-facing deposits for maximum hardness should be made using the longest acetylene cone in the flame that will produce a satisfactory deposit under the existing conditions.

(5) The hardness of the hard-facing overlay will be increased by "hot peening."

(6) A carburizing flame will melt the base metal more rapidly than a neutral or oxidizing flame.

(7) In depositing hard-facing materials by the electric arc process, the lowest welding current which will afford sufficient speed for the operation should be used.

(8) Single-bead deposits of hard-facing produce the hardest surfaces.

(9) Probable service life of a multiple-bead hard-facing deposit is unpredictable, because of surface cracks and other imperfections found in this type of deposit.

(10) Multiple-bead hard-facing deposits of a composite nature; i.e., a deposit formed by overlaying hard-facing material on a high carbon deposit, are the most economical when multiple-bead deposits are required to obtain the desired thickness of deposit.

(11) A multiple-bead composite deposit of hard-facing produces a harder deposit than can be obtained from a single-bead hard-facing deposit.

(12) The application of hard-facing over applicator or filler bars is the fastest and often the most economical means of replacing large quantities of worn metal.

(13) The Brinell hardness number is not necessarily an index to the wear-resistant properties of a hard-facing deposit.

Letters to the Editor

Tool and Die Repairs

We have read your very interesting editorial in the May issue of *The Welding Engineer* entitled "Too Many Doctors." Basically, in our estimation, the facts set forth are true as far as welding on fabricated parts is concerned. However, we believe that there is a welding field that has been neglected. Mention is made in your editorial of the difficulties the welding industry has encountered in winning engineering acceptance to its principles.

The same difficulties are now present and have yet to be won in the field of fabricating and repairing of tools and dies.

The metallic arc method has been used very successfully in the past few years for the welding of all types of water, oil, air, hot work and high-carbon-high chrome steels such as high-speed steel. From experiments made with test specimens, micro-photographs have been made showing that the metallic arc method of repairing tools and dies is very satisfactory.

However, engineers and tool designers are still skeptical when broached on the subject of manufacturing of blanking, trimming, drawing and forming dies inexpensively by using a mild steel or medium steel as a base and depositing the cutting or working edges with tool steel electrodes of the proper type.

By diligent effort on the part of manufacturers of these types of electrodes, the opposition to this practice is being overcome and it will be only a matter of a short time before the process will be universally accepted.

In the metallic arc welding of tools and dies it is vitally important that the proper electrode be used and that the proper procedure for that particular electrode be followed, exactly as specified by the manufacturer of the electrode. This welding field differs from that of the ordinary welding of fabricated parts in that the operator must know what he is doing.

Mr. Lincoln's assertions that a welder has only to hold the end of an electrode at a certain distance above the deposited metal and advance same along the seam to be welded does not apply in this field. In the temperamental field of die welding the operator is a vital factor. He must have knowledge as to the type of tool steel he is welding, the characteristics of same, heat treatment incidental to the particular steel being welded and some basic knowledge as to what is happening during the welding operation.

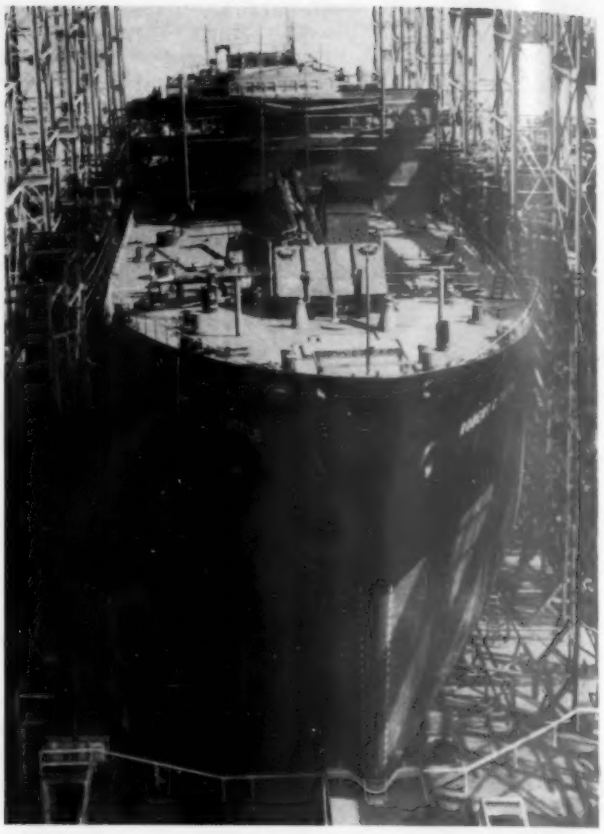
There are so many different types of tool and die steels on the market that the welder must have knowledge as to their various characteristics in order to be able to weld all tools and dies.

There is a crying need for educational facilities for men who contemplate the metallic arc welding of tools and dies to meet the future universal acceptance of this process.

A. R. Butler,
Welding Equipment & Supply Co.,
Detroit, Mich.

(*Continued from page 27*)

finished weld that is ready for painting. Then, too, buckshot is hard to remove at times. Fortunately, the use of any one of a number of good spatter protectors that may be brushed or sprayed along the line of the weld before welding will save much cleaning time later. Usually a light wire brushing will remove splatter after one of these compounds has been applied. The cost of the compound is a small fraction of a cent per foot, but its use substantially reduces final cleaning costs.



S.S. Robert C. Tuttle on the building ways at "Sun" shipyards, Chester, Pa. This newest addition to Atlantic Refining Company's welded tanker fleet will soon go into service on the run between Philadelphia, Pa. and Texas Gulf ports.

Some of the Practical Difficulties Encountered in

Welded Ship Construction

★ Part 2—A plain recital of "Joe McGee's" daily trials and tribulations in a big shipyard—Difficulties encountered because of variations in power supply voltage.

By FLOYD R. GORMAN*

THE FOLLOWING RECITAL of welding experiences is general and does not refer to any particular establishment, individual or organization. At the start of a shift, the welders report to their supervisor and are assigned to their respective locations aboard ship or on welding slabs. Let us follow those assigned to the ship and note the men milling about searching for a welding lead. Joe McGee, having found one suitable to his location, begins to extricate the length of it from among several others, including air hose and temporary light cords which are entangled around various objects. If the welding cables had quick make-and-break connectors, Joe could have broken one nearby and pulling out the loose ends, reconnected and been on his way.

Instead, we watch him haul and tug and occasionally drop the coil and walk some distance to release the cable which has hung up on some object. After finally getting his cable to the location, he has to start tracing it out to the welding machine, as he has no way of knowing to which machine or grid it is connected, since the cable does not have a metal identification tag attached near the electrode holder. Then he starts and makes a trial adjustment of the machine, but by this time he is usually in a sweat and slightly winded so he takes time out to cool off before starting to weld.

The average welder is not accustomed to strenuous exercise, because the major portion of his working time is spent in leaning, reclining or sitting to prevent sway of the body. He has a natural aversion to pulling cable and would welcome the assistance of a helper

*Part 1 was published in the May, 1940 issue, pages 17-19.

whose services could be used in stringing out the welder's cables, especially for the night shift. The locations for the night's welding being known before the close of the day shift, a helper may save many times his cost by stringing extra cables to the locations, which by means of the quick make-and-break connectors could be tied to the nearest available machine, thus permitting the night welder to start welding immediately.

The abandoned cable could then be coiled up at leisure, or placed in position for some other job to which the production welder may be moved later on in the shift. The helper may later station himself near the welding machines to adjust them for welders who find the previous adjustment unsuitable for their particular job. Some welders will worry along with an improperly adjusted machine rather than climb out to adjust it. Others will select a medium current and use that for all classes of work during a shift, while still others will spend half the shift running back and forth trying to find their favorite welding current. A helper circulating among a group of welders will increase production by attending to their wants and thus keep them busy on the job.

Joe, after getting himself lined out, begins to weld and has proceeded to a point where the parts are not fitted as close as desirable. There being no alternative but to continue the weld, he enlarges the puddle and as a result of the increased heat input the deposit becomes increasingly fluid, until he loses control momentarily. The metal runs or the bead rolls and he is faced with the necessity of getting this chipped out, or incorporating it in the weld on the next pass. He would in all probability chip off a misplaced deposit, an irregular tack, or enlarge a slag pocket if he had an ordinary hand hammer and flat chisel. Not having either in his kit he does the best he can which usually results in a large lumpy weld or a serious stress riser incorporated in the weld.

Having welded the first bead or layer, he then tries to clean it properly to receive the next pass. He grabs a handful of electrodes and

The S.S. Robert C. Tuttle, new 19,405-ton tanker, in the Delaware River immediately after her launching at Sun shipyards, Chester, Pa. Photo (Atlantic Refining Co.).

gives it a swipe, removing the surface slag. He seldom uses the small hand brush usually found in welders' kits to clean slag, because the bristles are not stiff enough to dislodge stubborn particles in the grooves between beads. He has no time to peck out each individual pocket with the usual scaling hammer, which is most often homemade out of a flat chisel with a point at one end and a bent electrode welded to the middle for a handle. Infrequent sharpening and severe usage has so blunted the ends of this hammer that they hardly resemble a cutting edge or a point to get at slag in pockets and grooves.

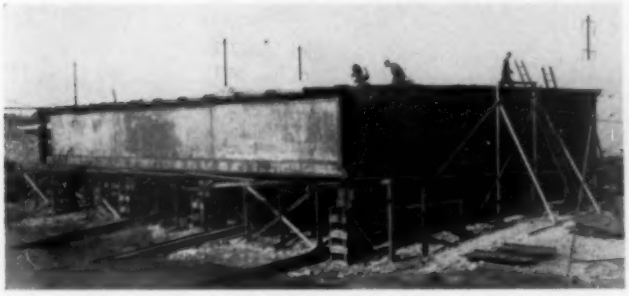
Consequently the stubborn particles remain as a refractory substance which has a higher melting point than deposited metal and does not float to the surface of succeeding passes, resulting in minute porosity. A fairly efficient slag remover may be made from scrap material such as an 8 in. section of ¾ in. O.D. pipe. Fill the pipe for half its length with scrap steel lifting cable, leaving about 1½ in. protrude and hammer the end of the pipe flat to clinch the cable. Such a tool will remove the most stubborn slag from between beads and at the toes of fillets. It is not desirable to fill both ends of the pipe because if one end is left free, the tool may be carried in the hip pocket for ready use on vertical and overhead work. A length of 8 in. or more is desirable for leverage and to prevent "barking" the knuckles in close places.

Some welders insert a piece of broken file in the other end which they use as a scraper for paint or other foreign substances. As the bristles wear down they may be lengthened by unclinching the pipe and pulling out the desired amount, then reclinching. The bristles may be given new scratching efficiency when they become dull by touching them to an emery wheel occasionally. However, the author strongly recommends that welders' tools be repaired and kept in good condition by the welders' tool room.

Back on the job, Joe is having difficulty because of current fluctuations in the welding circuit, and it is found that the driving motor of the welding sets is supplied with power from inadequate generating capacity, which also supplies current to various shops, cranes, etc. The variable load conditions contribute to wide fluctuations in the power supply and since the performance of welding sets is greatly influenced by the constancy of the voltage of the primary or motor circuit, a 2 or 3% variation in the normal line voltage will vary the speed of the driving motor and change the output of the welding generator.

It is a common belief among a great many people that the welder can control such fluctuations by lengthening or shortening the arc. This belief is entirely erroneous because good welding requires a very definite arc length. It must be remembered that the melting rate of the electrode is a function of the current rate, and the weld metal deposited during the surge of heavy current is not bonded sufficiently, due to lack of the time element to preheat the base metal for its reception. When the current rate is decreased the melting rate is also decreased. In this case the preheating period is unduly long and the volume of the deposited metal is insufficient to cover the melted area of the base metal.

These sudden variations usually occur before the welder realizes the necessity for changing the arc length or his rate of progression. Consequently, the metal piles up during the surges and strings out when the current decreases. Even should the welder be poised in anticipation of the variation, the following numerical values are



Fabricating an arc welded barge at plant of Welding Engineers, Inc., Trenton, N. J. Photo (General Electric Co.)

given to illustrate the physical improbability of adjusting the arc length in proportion to the variation. Given a set adjusted to deliver 100 amp. against a potential drop of 20 volts across a ⅛ in. arc gap, a 2-volt drop in the welding voltage would require $\frac{1}{32}$ in. decrease in the arc length to compensate for it.

Similarly a 2-volt increase in the welding voltage would require a $\frac{1}{32}$ in. increase in arc length. Many generators are equipped with either separate or built-in reactors which serve to smooth out such small unavoidable minimum changes as mentioned above. Therefore, if the voltage varies more than 2 or 3% and if good welding practice restricts the arc length to that governed by the characteristics of the electrode, it is difficult to imagine the welder working the arc like a pump handle and at the same time doing a good job of welding.

Joe is next seen trying to turn out a satisfactory weld on the framing, when he encounters a heavy piece of angle iron tacked with the heel hard up in the angle of the intersecting members. It was placed there by a structural mechanic who used it to line up one of the members. Having served its purpose, but not removed, it is an unnecessary obstruction preventing welding of the area which it covers and often by its presence creates an awkward position for the welder to get at the adjacent areas. If Joe has not already lost patience, trying to do a good job of welding, he gets around it the best way he can only to find another one, or a series of large nuts or washers tacked in the way of the weld. He is "fit to be tied" when he finds that some industrious painter has jumped the gun and painted up a large area he is to weld. Any kind of paint, if fresh, will cause excessive gassing and fluidity of the deposit until it is difficult to control, resulting in heavy undercuts and porosity.

There is, and has been, entirely too much dependence placed upon the average welder, without giving him the necessary wherewithal in training, equipment and cooperation. One of the most serious problems is to secure coordination between the welders and the erection group, and in this laxity lies a great weakness of welding. Competent welding supervisors properly trained and on their toes can go a long way toward raising the general quality of welding. If the locations for the next shift's work are inspected by the supervisors and necessary obstructions removed, broken tacks cut out and retacked, and all joints properly prepared, rest assured that the welders will give a good account of themselves.

» «

Readers' Question Box

A Chance To Make $5

In this issue we are repeating our "Readers' Question Box" for the purpose of helping our readers solve some of their difficult welding problems. Whenever such problems of general interest are encountered, we shall be glad to have readers submit questions for this department. In this way other readers of The Welding Engineer will have an opportunity of submitting solutions. We will pay $5.00 each for the best replies received and accepted for publication. All replies submitted should be extremely brief, approximately 300 words in length.

Cracked Fillet Welds Caused by Shrinkage Stresses

In welding heavy slabs, 3 to 6 in. thick, with carefully machined surfaces, usually in the form of a T connection, using ⅜ or ½ in. fillets, we too frequently encounter cracked welds. Apparently the trouble is due to shrinkage stresses set up by the inability of the heavy slabs to yield sufficiently to prevent cracking. The material is ordinary low carbon structural steel welded with a mild steel coated electrode.

What type of welding procedure will eliminate this cracking of welds? The average length of these welds is 3 ft. (W.N.M.)

(1) Suggested Solution

A mild steel electrode with a relatively high ductility should be used in solving the problem submitted by W.N.M. In making a T connection, the first step is to tack weld each corner following the sequence A, C, B, D, as marked in Fig. 1. These should be heavy tack welds about 2 in. long. They should be peened with an air hammer and a blunt-nosed tool. Then preheat the area to be welded to a temperature hot enough to make a drop of water "dance" on the plate. Do not attempt to make the fillet weld in one or two passes, but use stringer beads alternately on each side and peen each bead immediately after welding. Do not allow the joint to cool between passes and after completion of the welding, the joint should be covered with lime, sand or placed in an annealing oven in order to retard the cooling.

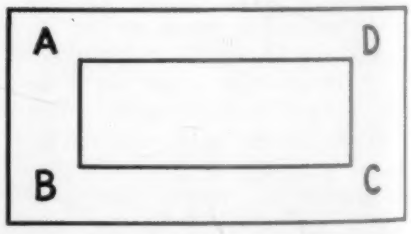


Fig. 1—Suggested sequence for making tack welds at a T connection.

To summarize the procedure: Use an electrode of high ductility; employ an alternate welding sequence, peen each bead and cool slowly. With butt joints in heavy plate, the same procedure should be used. (Signed) Roger L. Chaney, Columbus, Ohio.

(*Continued on page 40*)

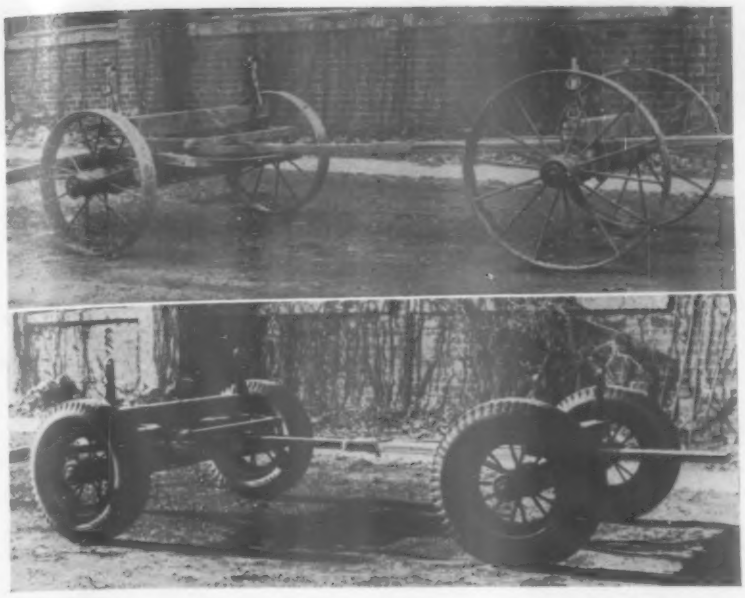


Fig. 1A—Steel wheel running gear of wagon before changeover to pneumatic tires. If hub is in good condition, such wheels can be easily equipped with drop center rims and used tires. Fig. 1B—Same wagon after the changeover.

Cutting Down Steel Wheels for Rubber Tires

By DONALD K. STRUTHERS*

★The value of agricultural implements and machinery in the United States totals $3,301,654,500. The maintenance of this investment in agriculture, as in any industry, is a huge problem. Without maintenance and repair the value of this investment in equipment would decrease rapidly. In addition, it is likely that the quality and quantity of agricultural products produced by machinery would decrease.

The average farm machine spends approximately 96% of its life "just sitting around." The other 4% is spent in useful work. This in itself makes farm machines costly to own. But to have a delay, due to a breakdown, adds to the cost through loss of quality and quantity of crop, to say nothing of the aggravation, inconvenience and loss of laboring time. A broken belt tightener on a threshing machine can keep 15 men idle until it is repaired or replaced. As in all machines, not all breakages can be foreseen.

On a great many occasions the welder in a rural community is more urgently needed than the family doctor. A good welding shop does not go unappreciated in an agricultural community. The service a welder can render his community depends upon his initiative, his resourcefulness, his skill and his equipment. He must be ready to meet any one of a hundred different situations. It is not uncommon to walk into a welding shop during the busy season on the farm and find six or eight other farmers waiting to have welding done, each with a different piece to be fixed.

The need for maintenance can roughly be classed under three causes, namely, (1) natural and expected wear of frictional surfaces, (2) accident and (3) breakage due to excessive stresses resulting from shock. Plow shares are an example of natural and expected wear. All farmers expect to take their plow shares to the shop at least once a season and sometimes oftener.

Fig. 4—Bending one set of spokes upward to fit drop center rim to the hub. Spokes are bent cold.

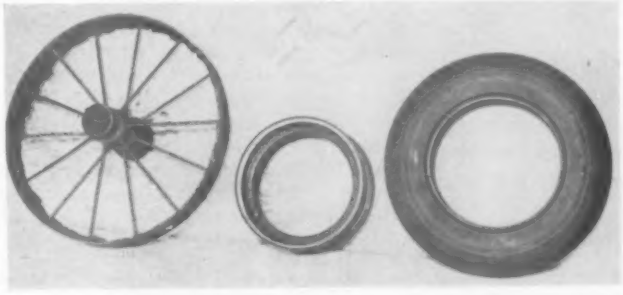


Fig. 2—A steel wheel, a drop center rim and a used automobile tire—the three essential parts in a changeover.

Fig. 3—Mechanic is marking exact spot where spoke must be flame-cut. In this case spokes will be cut 5¼ in. from outside of hub.

*Digest of paper presented at 40th Annual I. A. A. Convention, Milwaukee, Wis., April 10-12, 1940. The author is extension agricultural engineer, Iowa State College, Ames, Iowa.

Fig. 5—Centering the hub within the rim by using calipers. Measure from definite position on inside of hub to outside of rim. A jig would hasten this job.

Fig. 6—Frequently the cost of a rebuilt wheel as shown above will be less than either a replacement steel wheel or a new wheel with drop center rim.

It is evident that a farm machine equipped with rubber tires will last longer, pull easier, be more comfortable to operate and can be pulled at higher speeds than a similar machine fitted with steel wheels. Many new farm machines now being sold are fitted with rubber tires. However, practically all of the wheeled equipment represented in the $3,301,654,500 investment mentioned previously is fitted with steel wheels. A great number of these machines could be equipped with rubber tires.

During the past year agricultural engineers at Iowa State College have had good success in cutting down steel wheels, welding drop rims to the hub and spokes and then mounting used automobile tires. Many welding shops have been doing this to some extent, but have not taken full advantage of the opportunities afforded in an average farming community. Many steel wheels are broken and need replacing. We have been able to take such wheels and fit them with used automobile tires at a cost less than that of new steel wheels.

Technical Literature

We have listed below brief reviews of new technical literature prepared by welding equipment manufacturers. Any literature you may desire will be sent to you free of charge. Merely check or mark serial number of paragraph on order blank at bottom of page. Students are requested to write direct to advertisers for literature.

Ace Spot Welders

(182) **Pier Mfg. Co.** has issued a catalog No. 40, describing its complete line of Ace Spot Welders. Various models are shown and also a newly designed contactor and latest type of operating mechanism as used on the 1940 models. The catalog includes a discussion on the advantages of manual and automatic types in order to help the prospective user choose the type best suited to his needs.

Torit Dust Collectors

(183) **Torit Mfg. Co.** has issued a four-page bulletin describing the new Torit Dust Collectors which are self-contained units designed for the purpose of carrying away dust-laden air in the vicinity of polishing and grinding wheels. The bulletin shows how the dust collectors are built and suggests methods of installation.

Metcolizing Process

(184) **Metallizing Engineering Co.** has issued Bulletin P-11 which describes in detail a new process of Metcolizing which is said to afford good protection for metal exposed to heat. This process is stated to be economical and efficient for coating iron and steel against oxidation and scaling at elevated temperatures. The bulletin includes photo-micrographs and points out numerous industrial applications.

Victor 1940 Catalog

(185) **Victor Equipment Co.** has issued a 40-page, well-illustrated catalog of its welding and flame-cutting equipment. An outstanding feature of the new catalog is the use of colored illustrations to explain exclusive design features of Victor equipment. The Victor line embraces welding torches and nozzles, cutting torches and tips, special heating torches, pressure regulators, gauges and miscellaneous fittings.

Silver Brazing Alloys

(186) **Handy & Harman** have published a reprint bulletin "Silver Brazing Alloys in the Marine Field." This bulletin (28 pages) is reprinted from the Journal, American Society of Naval Engineers. Subjects covered include joint designs, tensile strengths, brazing procedures and electrical conductivity of brazed joints.

Norton Service

(187) **Norton Co.** has issued a folder which features their consulting engineering service to help grinding wheel users select the right wheel for the job and to help them reduce grinding costs.

Wilson Arc Welding Electrodes

(188) This is a 24-page profusely illustrated bulletin describing the various types of Wilson arc welding electrodes for flat, vertical, and overhead welding of mild steel and other ferrous metal compositions. Special electrodes are described for A-C. welding, carbon-moly, low-alloy high-tensile steels and also the Wilson No. 97 electrode for cast-iron welding.

Empire Fire Brick

(189) **A. P. Green Fire Brick Co.** has a folder describing the new high heat duty fire brick which has an application in welding shops in connection with preheating of large castings prior to welding. This brick can also be used to build annealing furnaces.

Dalweld Cable Connectors

(190) A small folder issued by the **Dallett Co.** lists the exclusive features of the Dalweld detachable cable connectors. This device has a quick-acting locking sleeve and is available with either soldered or solderless connections. The Type M is rated 400 amp. the Type S is rated 600 amp.

(Continued on page 40)

THE WELDING ENGINEER June, 1940
506 So. Wabash Ave., Chicago, Ill.

Please send me the literature as checked [X] on the list below:

182 ☐	185 ☐	188 ☐	191 ☐
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New Product Developments

Automatic start-and-stop device on Wilson "Hornet" arc welder.

Automatic Start-and-Stop Device for Arc Welders

★ In an effort to eliminate the waste incurred from frequent idling of an arc welder between jobs, the **Wilson Welder and Metals Co., Inc.**, New York City, has announced a new automatic start-and-stop device. It is for use on any magnetic starter, motor-generator arc welder, such as the Wilson "Hornet", driven by an a-c. motor.

With this Wilson device, the operator starts the welding unit simply by touching the work with his electrode holder. As long as he is welding, the unit keeps running; when welding is interrupted, the machine automatically stops after a time delay, which may be set between ½ to 1½ min., to suit the conditions of the particular job at hand. The time delay prevents undesirable frequent stoppings in case of a tacking job.

The standard device is reconnectable for 220 or 440 volts, or it may be supplied for other a-c. voltages (60 cycles only). It is easily installed either on or near the machine. Further information about the new automatic start-and-stop device may be obtained by writing to **Wilson Welder and Metals Co., Inc.**, 60 East 42nd St., New York City.

» «

Series-Capacitor System Improves Power-Factor in Resistance Welding

★ The widespread increase in use of resistance welding has led to its application in fabrication of larger and larger sections. This gradual development has tended toward increasing the size of welding machines, which in turn has introduced the problem of power supply. As an aid and possibly a solution to this problem, **General Electric Co.** has developed a new series-capacitor system, consisting of a capacitor equipment connected in series with the transformer primary of the resistance welding machine and of the proper rating to improve the power-factor of the welding circuit to approximately unity. This equipment can be applied to spot, projection, seam, and butt resistance welding, and is used with both synchronous and non-synchronous control. It may be applied to existing welding machines, by suitable modification, as well as to new applications.

The series-capacitor is made up of individual Pyranol capacitor units mounted in a suitable supporting rack. Such racks are available for floor, wall, or ceiling mounting.

With this new system it will be possible to operate resistance-welding machines at or near unity power-factor, thus reducing the kva. demand 50 to 70% and lowering power costs, minimizing line disturbances, and interference between welders and other electric equipment.

» «

Smith Type J Acetylene Generator

★ Perfect regulation of outlet pressures, cooler, cleaner gas and complete elimination of the "hot belt" are features claimed for a new line of two-stage portable acetylene generators announced by **Smith Welding Equipment Corp.**, Minneapolis, Minn. These new units are known as Type "J" and are listed by Underwriters' Laboratories, Inc., and Factory Mutual Fire Insurance Companies.

All water in the generator chamber is circulated by a non-mechanical air lift device which simultaneously cools and scrubs the newly generated acetylene gas. This completely automatic circulation of water within the generator results in elimination of the customary "hot belt" at the water line.

The size 14 ND carbide is fed into the water as needed by a large pressure-regulating diaphragm type feeding mechanism. Generated acetylene passes through the water circulating device through the hydraulic back-pressure valve and filter tank. Here it passes through another pressure regulator which may be set at the desired outlet pressure. This regulator has a large 6-in. diaphragm and controls the flow of gas so as to eliminate any fluctuation of pressure.

Smith Type J acetylene generator.

Simplicity of operation and portability are additional features in these generators, which are available in 15, 30, and 50-lb. sizes. For further information write to **Smith Welding Equipment Corp.**, Minneapolis, Minn.

» «

Automatic Hoop Forming And Welding Machine

★ In the production of butter kegs, nail kegs and other shipping containers, a large quantity of metal hoops is used. It has necessarily, in the past, required several operations to complete the manufacture of these hoops.

The **Federal Machine and Welder Co.**, Warren, Ohio, has recently developed for one of its customers, a completely automatic machine, which takes the wire from a supply reel at a uniform speed of approximately 150 to 175 ft. per minute. This wire is then drawn through

Automatic welder for forming barrel hoops.

two-plane, quick release, straightening rolls by a double set of spring-loaded pinch or drive rolls. The straightening equipment is all mounted on a floating carriage as may be seen at the left of the photograph.

The wire then passes through three adjustable forming rolls and into a sizing ring, where it is formed into a hoop of the required diameter. After the hoop has been formed, it is sheared to the exact circumferential length, welded and automatically ejected on a stacking fixture. A special arrangement for counting the hoops as they are ejected from the welder on to the stacking fixture is arranged to operate a limit switch so that when the required number of hoops (which is approximately 250) is placed in the stacking fixture, the fixture is tripped automatically and a new stack starts to pile up without affecting the production of the machine.

This particular machine was arranged to weld rings of 10 or 11 gauge wire, 14 to 15½ in. in diameter. These rings were held to accurate limits, having a tolerance of .005 in. in diameter, and after they were ejected from the machine, they were flat, within ⅛ in.

The unusual feature of this machine was the high rate of production—1500 to 1800 hoops per hour. The only labor required is that to load the coil of wire in the reel and to remove the completed hoops in stacks of 250. While this machine was developed for certain sizes of rings, the same method could be used on almost any size of wire, within certain limits, and any diameter of ring.

» «

Welding Electrodes For Draw Dies

★ The **Welding Equipment & Supply Co.** of Detroit, Mich., announces an addition to its regular line of Eureka tool steel electrodes. This new product is known as "Drawalloy".

These electrodes are readily applicable in the repair of all types of used cast-iron or medium-hard steel drawing and forming dies. They are recommended for use on new die construction to meet the extraordinary wearing conditions that exist on sharp contours such as character lines, belt lines, sharp radii, etc., or where the average base metal does not stand up under these extraordinary conditions.

These electrodes are especially adaptable on very sharp drawing or forming contours, which require a weld deposit resisting wear, metal pick up and frictional heat set up in drawing operations.

The depositions made with Drawalloy are highly resistant to metal pick up, being austenitic or non-magnetic. The deposits are medium-hard, 240-260 Brinell, as welded and work harden in use. Drawalloy also takes an exceedingly high polish which is beneficial in all drawing operations.

Drawalloy is furnished in ⅛, 5/32 and ¼ in. sizes, 18 in. long and comes packed in 10-lb. containers.

» «

New Face Shield Features Replaceable Plastacele Window

★ A new face shield with a plastacele window which slides in and out of a fibre frame, making replacement easy is announced by **The Boyer & Campbell Co.**, Detroit, Mich.

Besides simplifying replacement, the fibre frame affords considerably more face protection than the conventional metal bound type it is claimed. This frame is interchangeable on all models of B & C face shields, except 10 and 20, making of the No. 40 "four-and-one" shield a "five-and-one" model. The "five-and-one" are:

(1) The new fibre frame with replaceable plastacele window, which is well

Face shield has renewable plastacele window.

adapted to spot, flash, and gun welding, buffing, polishing, wire brushing, etc.; (2) A 24-mesh Monel screen window recommended for babbitting, heat protection, heavy scale, band sawyers, etc.; (3) fibre front and glass holder that gives complete protection for acetylene welding, cutting, scarfing, etc.; (4) fibre crown and rubber apron, which gives broad protection for acid workers; (5) The conventional type of metal bound plastacele window.

» «

5-KVA. High-Speed Spot Welder

★ The **Eisler Engineering Co.**, Newark, N. J. has introduced a 5 kva. high-speed production spot welder. This welder is an air-operated, vertical press type machine supplied with a suitable automatic

Eisler 5-kva. spot welder.

timer and contactor. Two operators are used for this welder, one to load the welding fixture, and the other to operate the foot switch and slide the fixture along after each weld.

The objects shown in the photo are cylindrical shaped tubes, to which small flat pieces of metal are being spot welded. The operator can attain a speed of 150 spots per min. This machine could easily be adapted for many other types of spot welding jobs.

» «

Reaction Soldering—A New Method of Metal Joining

★ Reaction soldering is a new, effective, high speed method of joining metals. It eliminates the iron tinning, fluxing and the conventional solder bar. It acts somewhat like brazing, but is carried out without the high temperature of brazing.

Reaction solder is a powder, which contains a combination of selected electro-positive metals, with chemicals, to form a chemical reaction with the metals which it joins. The reaction is fast, depending only on the application of relatively low heats. These low temperatures eliminate burning, twisting, warping and annealing, especially of light gauge metals.

The application is simple. The reaction solder is applied to the joint (in powder or paste form) and heat is applied. The methods of heating are not limited. A heating flame, oven, soldering iron, electric resistance or other methods may be used.

It is claimed that reaction solder is not restricted to one metal or one group of metals. Iron, steel, stainless steel, copper, bronze, nickel, tin, aluminum, aluminum alloys, Monel metal, brass and other metals can be joined with this material. It also acts as a filler for breaks, cracks, etc. in **castings** of the above metals.

For further information write to **Colonial Alloys Co.** and Associated Companies, Colonial - Philadelphia building, Philadelphia, Pa.

» «

Nu-Arc Transformer-Type Welder

★ Four sizes of Nu-Arc welders are announced by Nu-Arc Welder Corp., 1841 Broadway, New York City. Each model provides a heat stage selection by means of a simple panel board with a cable plug set-up for quick, easy adjustment of welding current. These transformer-type welders have double windings (primary and secondary) and the insulation conforms to A.I.E.E. requirements. Ample ventilation is provided by a top louvre and a screened bottom. The following current ratings and electrode sizes are offered:

Model 1—15 to 150 amps.—17 heat stages—1/16 to 5/32 in. electrodes.
Model 2—15 to 200 amps.—19 heat stages—1/16 to 3/16 in. electrodes.
Model 3—15 to 200 amps.—19 heat stages—1/16 to ¼ in. electrodes.
Model 4—30 to 450 amps.—25 heat stages—3/32 to ⅜ in. electrodes.

(*Continued on page 39*)

Among advantages claimed for Nu-Arc welders are: Absence of moving parts, dials or gadgets, switches or meters, and reduction of maintenance to the absolute minimum.

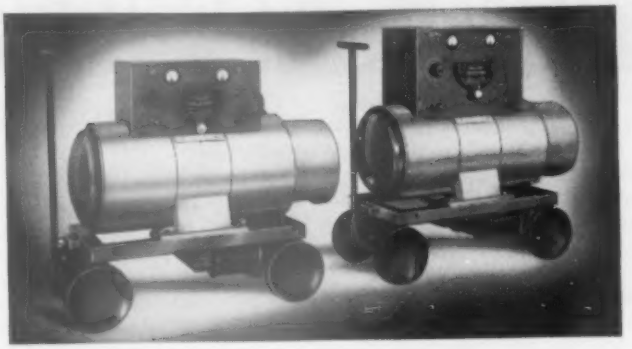
With Nu-arc the welds are uniform, whether on light, medium, or heavy material. The Nu-arc gives a steady, non-blowing arc in all positions and locations, on either light or heavy material. As a result, neater work is possible, and the necessity for reworking welds is largely eliminated, it is stated.

Nu-arc welding sets are designed to weld satisfactorily when used with any of the various types of coated electrodes which are regularly supplied for a-c. welding. The normal open-circuit potential of the secondary circuit is 60 to 90 volts, depending on the current used and

Advantages claimed for Nu-Arc a-c. welder include: No moving parts, no dials, gadgets, switches or meters.

selection of the proper voltage is inherent in the Nu-arc. For the purpose of striking and holding the arc, instantaneous transient potentials of the order of 130 volts give the operator the advantage of a much higher open-circuit potential without its attendant danger. These instantaneous potentials result from the oscillatory currents generated in the Nu-arc and provide extremely rapid changes in voltage which occur automatically with changing arc conditions. In other words, the Nu-arc is capable of storing energy and making this energy automatically available when required.

Inspection of the interior of the Nu-arc may be made after removing the cover. To do this, it is necessary to remove the bolts which secure the rim of the cover to the frame. With the cover removed, access is provided to the connections, terminal boards, control panel, transformer, reactor and current regulator. It is also possible, when the cover is off, to either adjust or remove the current regulator.



Hollup "Speedarc" synchronous motor-driven arc welders are made in 150-200-300-400-500 and 600 amp. capacities.

Hollup "Speedarc" Synchronous Motor-Driven Arc Welder

★ The Hollup Corporation of Chicago, Ill., has developed an improved d-c. arc welder which incorporates a synchronous motor instead of the conventional squirrel-cage induction type motor.

The machine includes a d-c. exciter, the armature of which is built on a quill and mounted directly on an extension of the motor-generator shaft. This exciter supplies current for the d-c. field of the synchronous motor and also supplies current through a field rheostat to the separately excited d-c. field of the welding generator.

The d-c. generator is provided with a series field having taps which are connected to the five-position dial switch. These combinations give dual control in that the position of the field rheostat determines the open-circuit voltage of the generator and the position of the dial switch determines only the current which will be delivered.

The exciter circuit is connected to a small enclosed toggle switch for reversing the polarity of the generator terminals for various types of electrodes. Since the generator is separately excited, the polarity cannot be reversed except by throwing the excitation-reversing switch.

The synchronous motor is of the revolving armature type having stationary d-c. field poles mounted in the laminated magnetic frame ring, the same as the d-c. field poles of the welding generator. The d-c. poles for the synchronous motor have "damper" windings embedded in the pole faces. These windings are connected together so as to form a starting winding for the synchronous motor.

The motor has its armature winding connected directly to the power circuit for starting and running by a magnetic push-button type of starter. Due to the starting winding the motor starts the same as an induction motor, but as soon as it has speeded up to almost full speed, the exciter will have built up its voltage and will energize the d-c. field of the motor, which causes it to "pull into" synchronous speed, and the starting winding then acts as a damper only, and does not cause the motor to draw any magnetizing current from the line.

If a power-factor meter having "lagging" and "leading" scales is connected in the motor circuit, it will register "lagging" low power factor during the actual starting period, the same as any induction motor welder, but when it "pulls into synchronism" the power-factor meter will immediately jump to the "leading power factor" side of the scale. The actual leading power factor registered will depend upon the line voltage and the load on the generator. At full rated load on the generator (300 amps. 40 volts for a 300-amp. welder) the power factor will be 98% leading to 100%, and at no load (with the set running idle) it will vary from 80% leading to as much as 60% leading. On the other hand, induction motor driven welders will show power factors of 86% to 90% "lagging" at full rated load, and as low as 30% to 35% "lagging" power factor when running with no load.

Due to this characteristic of a synchronous motor, it is a much more desirable shop load, because it will actually improve shop conditions by improving the power factor and decreasing the kva. required by the shop. This means less current in shop circuits and from transformers. The voltage of the shop circuits will be raised and the voltage regulation improved. This will make all other induction motors on the circuits work more efficiently by drawing less current and running at higher speed. If power is purchased on a contract having a kva. demand charge, or a "power factor" clause which is enforced, then the power bills will also be reduced.

Tests are said to show that a plant operating 5 induction motor driven welders can replace them with from 8 to 12 or more of these synchronous motor-driven welders, without increasing the plant kva. load and at an improved plant power factor.

NOW IS THE TIME TO JOIN THE

American Welding Society

33 West 39th Street
New York City

News of the Industry

Attention!—Chicago Golfers

On Saturday, July 20, 1940, **Woodridge Golf and Country Club,** near Lisle, Ill., will be host to **Chicago Section A.W.S.** golfers in their Second Annual Golf Tournament. This sporty 18-hole course is located a mile and one-half south of Ogden Ave., on Route 53. An over-all charge of $3.50 will include golf privileges all day, as well as lunch and dinner. The Prize Committee announces that there will be plenty of valuable prizes for the hard-working turf-cutters and divot slingers.

W. C. ("Bill") Pearson, is general chairman of the Golf Committee and is being assisted by **Thomas H. Gallagher,** Chairman of the Prize Committee; **Harold Zeigler,** chairman of the Arrangements Committee; **I. J. Eales,** chairman of the Grounds Committee; and **O. L. ("Duke") Howland,** chairman of the Publicity Committee.

» «

Structural Steel Welding Research Committee

Formation of a Structural Steel Welding Research Committee to study problems of design and fabrication in the building field, is announced by the Engineering Foundation, research organization of the national engineering societies.

Leon S. Moisseiff, New York consulting engineer, and designer of the George Washington and Triboro bridges in New York and the Golden Gate and San Francisco-Oakland Bay bridges, has been chosen chairman. Other members are: **F. H. Frankland,** technical director of the American Institute of Steel Construction, New York; **Jonathan Jones,** chief engineer of Fabrication Division, Bethlehem Steel Corp., Bethlehem, Pa.; **C. H. Goodrich,** chief engineer of the American Bridge Co., Pittsburgh, Pa.; **A. S. Low,** vice-president of the Austin Co., Cleveland, Ohio; Commander **C. A. Trexel,** design manager, Bureau of Yards and Docks, United States Navy, Washington, D. C.; **La Motte Grover,** engineer, Air Reduction Sales Co., New York; Professor **Bruce Johnston** of Lehigh University. **H. W. Lawson,** engineer, Bethlehem Steel Corp., and **F. H. Dill,** engineer, American Bridge Co., have been named alternates.

The program includes the establishment of research fellowships in American universities. The first fellowship goes to Lehigh University for a two-year period and carries with it an annual stipend of $1,100. Other fellowships will be established as soon as the Committee maps a complete program of research projects. The investigations at Lehigh will be directed toward developing a satisfactory design procedure for beam-to-girder and beam-to-column connections for all kinds of welded building construction.

"The work of the Committee, in general, will be to secure basic data which will enable fabricators to apply welding in building with greater safety and with greater economy," it is explained. "By obtaining full information on the effects of varying loads on all classifications of welded connections, the Committee hopes to perform a service for building engineers and aid them in setting up different formulas which will be applicable in each type of construction. At present there is a wide diversity of opinion regarding the best designs for varions welded connections.

"It is important that engineers have at least one continuing body from which the results of research in this field can be obtained. Formation of the Committee will also assist the engineering profession in seeing to it that the development of structural welding is scientific and sound."

The Committee was organized by the Welding Research Committee of the Engineering Foundation, working in cooperation with the American Institute of Steel Construction. The research of the new group, it is planned, will tie in with the studies in welding literature, the Fundamental Research investigations now underway in various universities, and the projects of the Industrial Research Division, all of which are sponsored by the Welding Research Committee.

The first Structural Steel Research Committee was established about 15 years ago, but was discharged in 1938 after having exhausted its funds and completed the work originally outlined. The outstanding contribution of the body was the formulation of the American Welding Society Building Code which today is in standard use in more than 200 municipalities including New York City, Chicago, and Pittsburgh.

New Technical Literature

(*Continued from page 36*)

Glyptal No. 1294

(191) **General Electric Co.** has a two-page folder describing Glyptal No. 1294 which is used in welding shops to prevent adhesion of weld spatter. This product is available in three types, clear, red and gray. The red variety not only prevents weld spatter but provides corrosion protection; the gray variety provides suitable characteristics for resistance welding in addition to corrosion protection. (GE-3198A)

Tantung Welded Tip Tools

(192) **Fansteel Metallurgical Corp.** has a folder containing explicit instructions for making cutting tools with Tantung welding rod applied to steel shanks by means of the oxy-acetylene torch. Welding rod prices and standard welded tip tools are included. Another folder by the same company lists Tantung brazed tip tools for cutting steel. Tantung is a non-ferrrous alloy containing tantalum carbide. It has been developed primarily to fill the gap between high-speed steel and the cemented carbides in steel-cutting applications.

Reader's Question Box

(*Continued from page 34*)

(2) Suggested Solution

The difficulty described by W.N. M. is the inability of the heavy slabs to expand on account of their rigidity. Hence the molten weld metal in contracting upon cooling is stressed beyond the yield point of the metal. The difficulty is aggravated by the chilling effect of the cold plate metal on the comparatively small volume of weld metal. This rapid chilling causes embrittlement (loss of ductility) and reduces the weld metal's ability to absorb contraction stresses.

I would recommend the following procedure to overcome this difficulty: Preheat the weld area to 300 deg. F. This will slow up the cooling of the weld metal, will improve its ductility and will reduce contraction stresses. If ½-in. fillets are to be used, the welding should start in the center of the slabs using the system of intermittent chain welds, each link being 4 in. long. It is best to use two welders simultaneously, working on opposite sides of the plate. After the center 4 in. welding is deposited, the next step is to place a 4 in. length of fillet weld at one end of the slab. Following this, place additional 4 in. lengths of fillet welds at the mid-points of the un-welded spaces, continuing this intermittent welding until the joint is welded the full length of the slab.

If any cracking develops, using this procedure, it will be necessary to stress-relieve the weld metal by peening each 4 in. length of weld immediately after it is deposited. However, it should not be necessary to peen the first and last layers. (Signed) Ivan G. Smith, Bremerton, Wash.

Personals

R. L. Thomas is the newly-appointed factory representative of **Smith Welding Equipment Corp.**, in Alabama. He will have headquarters at Birmingham.

» «

E. H. Anchors, formerly branch manager for the **Air Reduction Sales Co.** at Atlanta, Ga., has been appointed manager of the Oklahoma City District. Mr. Anchors began his career 15 years ago with the Commercial Acetylene Supply

E. H. Anchors

Co. He was Southern manager of this company when it was acquired by Air Reduction. Since that time he has served continuously as branch manager at Atlanta.

» «

C. K. Bryce has been elected vice-president of **Oxweld Acetylene Co.**, a unit of **Union Carbide and Carbon Corp.**, New York. Mr. Bryce was formerly manager of factories.

» «

Walter S. Tower, executive secretary of the **American Iron and Steel Institute** since 1933, was unanimously elected president, chief executive officer and a director of the Institute by the board of directors at the recent 49th general meeting at the Waldorf-Astoria hotel, New York City. Mr. Tower succeeds **E. T. Weir**, chairman of National Steel Corp. who has served as president for the past year. In naming Mr. Tower, the directors adopted a policy of electing a paid president. During the past seven years executives of member companies have served as head of the Institute. In that period, presidents in addition to Mr. Weir has been **E. G. Grace**, president of Bethlehem Steel Co., and **T. M. Girdler**, chairman of Republic Steel Corp.

The election of a paid president of the Institute who will devote all his time to its affairs, is regarded as the first official move by the industry in gearing itself to be in a position to cooperate in the fullest measure in the government's huge national defense program. The development of that program is expected to place heavy demands upon the time of the chief executive of the Institute in dealing with problems of the industry and of relationships with other industries and with the government. Moreover the time and energy of each executive of the member companies will be fully occupied in their respective production problems.

» «

Stedman Joins Bastian-Blessing Co.—In announcing the appointment of **Gerald E. Stedman** as sales manager, Rego Division, **Ellsworth L. Mills**, vice-president in charge of sales of the Bastian-Blessing Co., 242 East Ontario St., Chicago, revealed what may be termed a new trend in industrial marketing.

"We believe marketing practice to be as susceptible to improved design as are the products," said Mills, "and, therefore, we intend to introduce streamlined selling methods into our Rego marketing activities, adapting the successful technique of general merchandising to our technical selling requirements. Greater use of sales research, dramatics, distributive stimulation, sales training and incentive will be employed.

"Our feeling is that too frequently industrial marketing methods are cold, unchanging, too technical in their appeal. We believe the warm promotional technique used in such general fields as home appliances, automobiles, and furniture can be successfully adapted to industrial selling with improved sales effect.

"In accordance with this viewpoint, we have secured the services of **Gerald E. Stedman**, who joins our management staff immediately. He has a brilliant record as a merchandising expert. Under his direction, the Rego Division expects to establish this newer note in industrial selling.

"Stedman is well known in merchandising, research, sales training and pub-

Gerald E. Stedman

lic relations circles. He has directed the sales planning for many notable successes. A business writer for many trade publications, Stedman maintains national contact with more than 10,000 merchants and salesmen and is a strong exponent of basing sales programs on actual field experience."

The Linde Air Products Co., a unit of **Union Carbide** and **Carbon Corp.**, New York, has announced the election of **T. D. Cartledge** and **L. A. Bliss** as vice-presidents, and of **E. J. Hayden** as vice-president, Central Division.

Mr. Cartledge as been general sales manager and Mr. Bliss, works manager of the Company. Mr. Hayden has been manager of the company's Central Division.

E. B. Suydam, formerly assistant general sales manager, has been appointed general sales manager to succeed Mr. Cartledge; and **P. B. Pew**, formerly assistant works manager, has been appointed works manager to succeed Mr. Bliss.

Trade News

Handy & Harman Enlarges New York Offices and Plant

Extensive additions and alterations at the New York offices and plant of **Handy & Harman**, 82 Fulton St., to more efficiently take care of an expanding gold and silver business, are nearing completion. Added floor space of more than 4,000 sq. ft. has been occupied at their present location.

The company's New York plant, located at the same address, has taken over the entire first floor of the building, adding to its facilities for meeting requirements for silver and an increasing demand for karat golds and gold solders.

The general office and sales department have been enlarged and considerable space has been given over to the handling of new silver business in the industrial field in addition to the arts. In recent years a large number of manufacturers of refrigerators, automobiles, airplanes, electrical appliances and metal products of all kinds, have become users of silver and silver brazing alloys. There has also been an increase in the use of silver for electrical contacts and for corrosion resistance in containers and equipment for the chemical and food industries, it is stated.

» «

21,000 Westinghouse Employes Given Awards—More than 21,000 employes of the Westinghouse Electric & Mfg. Co. will receive service award emblems in recognition of 10 or more years of service with the company. Of the 21,222 employes eligible to receive the award, 8 have been with Westinghouse for 50 or more years; 184 for at least 40 years; and 6,062 for a minimum of 15 years.

» «

Ebbert & Kirkman Co., 321 Brown Marx Bldg., Birmingham, Ala., have been appointed exclusive sales representatives for Alabama and parts of Florida west of the Apalachicola River for the welding tables and positioners as made by the **Ransome Concrete Machinery Co.**, Dunellen, N. J.

Titan Metal Celebrates 25th Anniversary

The story of an industry is the biography of a man, it has been stated many times. In 1913, **William P. Sieg** came to Bellefonte, Pa., with the intention of making that city an automobile center. His dreams faded but in place of an automobile industry, Bellefonte now has the **Titan Metal Mfg. Co.** with more than 600 employees and two well-equipped plants.

William P. Sieg

Mr. Sieg was born in Harrisburg, Pa., Sept. 26, 1876; educated in the public schools of Steelton, Pa., and obtained his first job with the Pennsylvania Steel Co. (now part of Bethlehem Steel). A few years later he was lured into the automotive industry and organized a company with headquarters in York, Pa., for the manufacture of an automobile. This venture, however, did not succeed.

During the early days of the World War, Mr. Sieg became associated with **Dr. C. T. Hennig,** metallurgist, who had developed some new non-ferrous compositions. Early development work was done at the Alpha Metal Co. in Bellefonte. Shortly afterward, the name of the company was changed to Titan Metal Mfg. Co., because it was thought to be more suitable. In 1917 Titan purchased the entire facilities of the Trenton Brass Co., Trenton, Mich., and moved them to Bellefonte, and then concentrated on the production of commercial brass rod and brass forgings. During the depression years of the early 30's, a $300,000 modernization program was carried out to build up the plant and to put it on a competitive basis. Mr. Sieg states that Titan now manufactures approximately 2000 different cast or forged items of non-ferrous analysis.

» «

The Champion Rivet Co., Cleveland, Ohio, has prepared a calculator of welding costs in the form of a slide rule of handy pocket size.

This device is reported to be the first attempt to display in chart form a set of welding cost standards which can serve as a guide to engineers and plant officials on their production welding where a definite and normal procedure is being followed. The new calculator is being distributed through all the sales offices of the company at a nominal charge.

» «

The Welding Table and Positioner Division of the **Ransome Concrete Machinery Co.,** Dunellen, N. J., has just appointed the following representatives to handle their line of welding tables and positioners:

Arcway Equipment Co., 3717 Filbert St., Philadelphia, Pa., have the state of Pennsylvania, Delaware, West Virginia, Maryland, Virginia and part of New Jersey.

Hobart Welder Sales and Service, 6715 Carnegie Ave., Cleveland, Ohio, will represent Ransome in North East Ohio.

» «

The Machinery and Welder Corp., St. Louis, Mo., with offices and warehouses in Chicago, Milwaukee, and Moline, Ill., has recently been appointed distributor in these districts for Eureka tool steel and alloy welding rods manufactured by the **Welding Equipment & Supply Corp.,** Detroit, Mich.

» «

Ryerson Host to 3,000 Visitors—Climaxing large-scale preparations to acquaint customers with Ryerson stocks and plant facilities, Ryerson's "Open House" at the Chicago Warehouse, May 11, was attended by more than 3,000 visitors. The huge crowd, which included many out-of-town guests, witnessed the opening of the new steel building and went on specially conducted tours through the entire plant, where many new services and products were on display.

» «

Cash For Suggestions—During the first three months of 1940, General Electric's suggestion system paid 31% more to employees of the Company than it did for the first three months of 1939. For January, February and March a total of $17,587 was paid for adopted ideas relating to their daily work as contrasted with $13,461 for the same period in 1939. The number of suggestions received for the period showed an increase of 11% and the number of suggestions adopted increased 21%.

» «

G. E. Sales Up 25%—Sales billed by the **General Electric Co.** during the first quarter of 1940 amounted to $85,949,194, compared with $68,537,269 during the same quarter last year, an increase of 25%.

Profit available for dividends amounted to $11,951,450 or 41 cents a share, for the first quarter this year, compared with $7,373,431 or 26 cents a share, for the first quarter last year, an increase of 62%. Orders received during the first quarter of 1940 amounted to $97,490,047, compared with $86,882,953 for the same quarter of 1939, an increase of 12%.

Current Reviews

Welding Health Hazards—A comprehensive study of the health hazards of electric and gas welding has been published in the April 1940 issue of the **Journal of Industrial Hygiene and Toxicology,** vol. 2, No. 4, pp. 125-148. This article is divided into three chapters, as follows: (1) Review of the literature; (2) Results of examination of 286 welders, and (3) Preventive measures. The article also contains a bibliography of 50 references. We quote below the summary and conclusions of the authors:

"A brief review of the various methods of welding, materials used and the potential health hazards has been presented. The literature on the effect on health of exposure to the by-products incident to the welding process has been reviewed.

"The clinical portion of this report, based on a study of 286 welders of an average length of service of 9 years, may be summarized as follows:

"1. While many hazards may exist as a result of the welding process, these can be and usually are controlled by the observance of ordinary precautions.

"2. Changes in the chest films after many years' exposure to welding fumes may occur. These changes are not accompanied by disability.

"3. In a comparatively large group of welders (about 1000) doing all types of welding, we have not observed any one disease entity to be outstanding in those disabled. Clinical syndromes in welders reported by others have not been observed.

"4. The disability frequency rate of welders has not been in excess of that found in a general group. The diseases found have otherwise not differed from those occurring in a general group of workers.

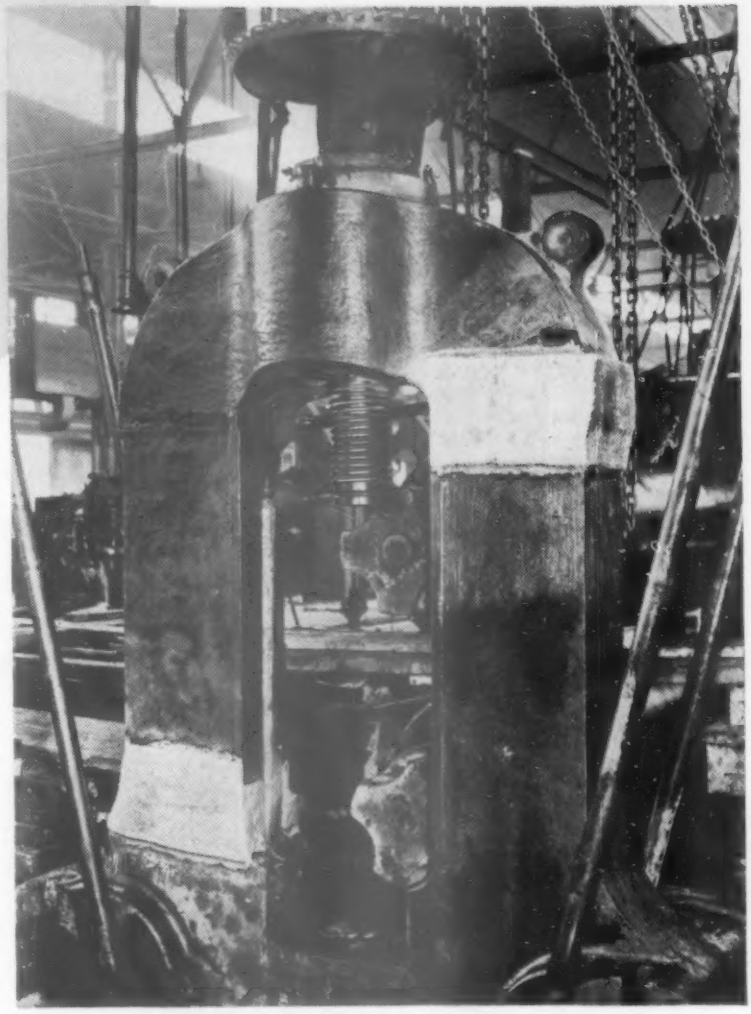
"5. There are hazards associated with any type of welding and troubles may develop as a result of exposure to these. However, when the hazards are considered and proper safeguards taken for their control, they should no longer offer a serious menace to health."

» «

"We Who Work at Our Industrial Jobs" is the subject of a pocket-size 24-page booklet just issued by the **James F. Lincoln Arc Welding Foundation,** Cleveland, Ohio. It has been prepared by **Ed. C. Powers,** assistant secretary of the Foundation, to direct attention to the vitally important part being played by men in industry, particularly engineers and designers. It is because of their efforts that we, in this country at least, enjoy such a high standard of living. The urge to seek improvements is the driving force behind all progress. In this booklet Mr. Powers pays well deserved tribute to the technical men in industry who are possessed with the urge to improve. He then explains how these men who make industrial advances and

How strong is a 400-lb. Tobin Bronze weld? How quickly can it be made?

The story of the repair welding of this 15-ton roll housing reveals the answers to these important questions...



LAST March 8, this huge housing on a 33" rolling mill cracked resoundingly and thundered to the floor. Production orders were heavy on this particular mill and a replacement could not have been made for eight or nine weeks. To save time, two temporary repair-welds with Tobin Bronze were tried. Welders, working steadily in two shifts, used 400 lbs. of Tobin Bronze 3/8" welding rods for each weld; consumed only nine days to complete the work. On March 17 the housing was back in place ready to go... So much for how quickly welds of Tobin Bronze can be made.

Production was resumed, the plant superintendent hoping that the repaired housing would stand up under terrific operating pressures of the rolls until a new casting could be obtained. Six months later that mill was still rolling its quota of metal. *What's more,* during this period, a roll neck broke in the housing. The abnormal stress that brought about the fracture in the heavy roll was absorbed by the welded housing with no sign of failure. Such service is proof positive of the high strength of properly made Tobin Bronze welds in cast iron.

Tobin Bronze welding rods are stocked by all leading supply houses. Make sure that when you buy Tobin Bronze it bears the trade-mark "Tobin Bronze—Reg. U. S. Pat. Off."—only then you will be getting the genuine. 40115

ANACONDA

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

improvements may obtain financial rewards, by participating in the $200,000 Industrial Progress Award Program sponsored by the Foundation. What steps are necessary to participate in the Progress Program are briefly and clearly summarized.

Recent Patents

Welding Electrode

2,200,887. **Henry C. Lockwood,** Brooklyn, N. Y. Filed April 8, 1937. Issued May 14, 1940. Electrodes are employed to produce pressure tight, continuous seam welds with continuous contact of the electrode with the work and with continuous application to the work of electric current of substantially constant mean effective value during the welding operation. A uniform, continuous seam weld is produced instead of overlapping spot welds. Thin stainless steel may be welded successfully by the use of the patented electrode. The electrode has an electrically conducting portion and an electrically non-conducting portion which engages the work at the weld area during the formation of the weld and through which the entire welding pressure is applied to the work. The conducting portion engages the work in electrical contact during welding.

» «

Blowpipe

2,197,979. **Homer W. Jones** and **Herbert W. Cowin,** Westfield, N. J., assigned to **Oxweld Acetylene Co.,** of West Virginia. Filed Aug. 30, 1938. Issued Apr. 23, 1940. The inventor points out that with various types of self-igniting blowpipes heretofore used with low-pressure fuel gas, difficulty has been experienced in maintaining a pilot flame at the blowpipe nozzle, when the main supply of combustible gas mixture has been interrupted. This action is due to the stoppage of acetylene to the pilot tip when flow to blowpipe nozzle is stopped. Flashback or burning is also possible, particularly in the type of pipe in which a pair of adjustable valves controls the acetylene and oxygen, and a second pair of quick shut-off valves controls the gas to the pipe tips. To overcome these difficulties, the inventor has devised a pipe in which the closing action of the quick shut-off valves is not completed until after the valve controlling the acetylene supply has been closed, while at the same time a small pilot flame is maintained on the blowpipe tip. The same time differential element insures that a reduced flow of oxygen to the blowpipe nozzle is initiated before the acetylene is turned on, thus preventing undesirable formation of soot due to too much free burning combustible gas.

» «

Flux Application

2,198,085. **Robert G. Le Tourneau, R. Petersen,** and **E. Isgren,** Peoria, Ill., assigned to **R. G. Le Tourneau, Inc.,** of Calif. Filed Feb. 23, 1938. Issued Apr. 23, 1940. To avoid breaks in the flux sheath and objectionable side jumping of current during welding with a flux, the patent teaches that the flux should be applied to welding rod in such a manner that the flux is disposed about the rod as it is fed, in the form of a continuous sheath, from a point beyond the point of contact with the welding current to the welding end of the rod. According to this patent the welding rod is fed continuously through a chamber which has an intake passage to permit plastic flux material to be introduced. The flux, containing a quick drying agent, such as waterglass, forms a sheath around the rod. The coated rod emerges from the coating chamber a short distance above the welding zone and is immediately employed in the welding operation.

» «

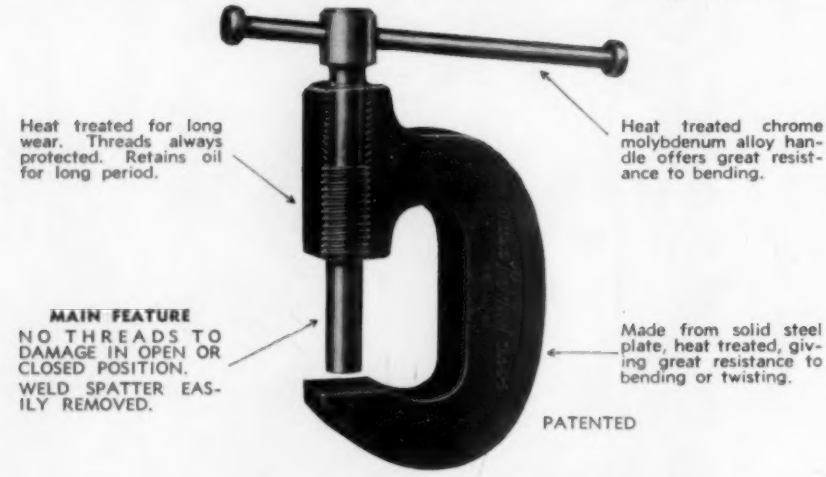
Structural Welding

2,198,264 and 2,198,265. **James V. Caputo,** Girard, Ohio. Filed respectively Aug. 7, 1933 and Nov. 2, 1933. Issued April 23, 1940. These patents describe electric welders for continuously flash welding structural shapes from substantially flat plates at high speed. The welder has

"Red Head"

WELDING CLAMPS

Withstands All Welding and Handling Abuses


Heat treated for long wear. Threads always protected. Retains oil for long period.
Heat treated chrome molybdenum alloy handle offers great resistance to bending.
MAIN FEATURE
NO THREADS TO DAMAGE IN OPEN OR CLOSED POSITION.
WELD SPATTER EASILY REMOVED.
Made from solid steel plate, heat treated, giving great resistance to bending or twisting.
PATENTED

14 STOCK SIZES

Special Sizes and Shapes Furnished for Special Applications

INDESTRUCTIBLE CONCEALED THREADS

Red Head Welding Clamps have been especially designed for welding service. Their construction eliminates the trouble caused by weld spatter or accidental damage to threads. A clamp that will stand up under the most rigorous service over long periods of time.

A trial will convince you. Send for sizes and prices today.

TERRITORIES OPEN FOR JOBBERS

CHICAGO BOILER COMPANY

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electrodes adapted to engage plates and to form them into shapes having a web and a flange. Such shapes include beams, channels, Z and T forms, and the like. The electrodes are supported for adjustment to and from the work. There are top and bottom electrodes and a pair of side electrodes co-operating with the vertically-placed electrodes.

» «

Blowpipes

2,198,341 and 2,198,342. **Wilgot J. Jacobsson,** Scotch Plains, N. Y., assigned to **Oxweld Acetylene Co.,** of West Virginia. Filed April 17, 1937. Issued Apr. 23, 1940. Blowpipes are described which are suitable for medium-pressure fuel gas without danger of flashback. It is customary to use the pressure of the combustion-supporting gas to aspirate the fuel gas. The inventor obtains effective gas mixing and gas travel without such aspiration. The new blowpipe is provided with an improved preheat gas mixing unit. The unit includes a nozzle assembly which has a nozzle, an elongated conduit, and a rear block, all rigidly connected together and disposed in an elongated cavity within the blowpipe. Two concentric gas passages, each with a metering constriction, are also provided. Both gas supply passages are long, have large capacity, and are adapted to contain a large volume of gas. These passages provide a resilient cushion behind the mixing point and act as pneumatic cushions to prevent backfiring. The metering devices also control the volume of gas supplied to the nozzle.

» «

Spot Welder

2,198,534. **Wayne A. Howard,** Manhasset, N. Y., and **T. C. Smith,** Huntington Park, Calif., assigned to **Socony-Vacuum Oil Co.,** of N. Y. Filed Nov. 4, 1938. Issued Apr. 23, 1940. According to this patent linings may be welded in place within completely formed cylindrical vessels with economy of time and labor and with dependably high quality of work. The device is suited for welding alloy linings in such vessels as those employed in the petroleum industry. The welding unit is supported within the vessel to be lined by means of a hoisting unit. A "series" or "duplex" spot welder is employed. The welder is adapted to operate in vessels of regular or irregular shape. The vessel may be vertically or horizontally disposed. Additionally, the device may be employed for welding the dish-shaped heads of such vessels. The welder is introduced in sections through a manhole in the vessel and is assembled or disassembled as the case may be, within the vessel.

» «

Resistance Line Welder

2,200,112. **Ralph A. Gilbert,** Pittsfield, Mass., assigned to **General Electric Co.,** of N. Y. Filed Dec. 1, 1938. Issued May 7, 1940. For certain welding operations it is possible to set the roller electrodes of a line welding machine for rotation in a given plane and weld along any desired path by moving the work relative to the electrodes. Frequently a rotary motion cannot be imparted to the work, because of interference between the work and the welding machine. The new machine has roller electrodes which may be turned bodily about their point of engagement with the work whenever such an operation is required. Thus in welding a bushing pocket to a transformer tank, when it is not possible to rotate the tank relative to the electrodes, the electrodes may be rotated relative to the tank. It is thus possible to make a single continuous weld wherever it is needed.

Manganese Flux

2,200,737. **Edwin A. Clapp,** Niagara Falls, N. Y., assigned to **The Linde Air Products Co.,** of Ohio. Filed Aug. 10, 1937. Issued May 14, 1940. Under some circumstances difficulties are encountered in producing a completely satisfactory weld by the use of calcium-magnesium-aluminum silicates containing calcium fluoride. It has been found that weld metal deposited through these materials loses manganese and gains silicon during the welding operation. Such a manganese loss is unfavorable if the steel workpiece has a rather high sulfur content, say 0.03% to 0.05%. Unsound

Features which assure SUPERIOR WELDING QUALITIES of

TITAN BRONZE WELDING ALLOYS

Use of Purest Raw Materials Obtainable, such as Electrolytic Copper 99.96 in purity and Electrolytic Zinc 99.99 plus.

Strict Laboratory Control; Uniformity of Mixtures and Casting Temperature.

Double-Deoxidation Process which eliminates injurious gases.

Penn Bronze—is a general purpose rod. It is low melting (1620° F.) and tins easily and uniformly on galvanized, malleable or wrought iron as well as steel, brass, bronze and any other non-leaded metal with a melting point above 1850° F. It makes tough high-strength welds of high ductility, immune to strain hardening and with great abrasion and corrosion resistance.

Titan Manganese Bronze—is used where both hard and tough welds are desired. Although this is a general purpose rod, it is especially recommended for cast iron. It is free flowing and gives extremely dense, non-porous welds.

Titan Bronze—is a tin bronze with uses and characteristics similar to the manganese alloy; penetrates seams and crevices readily.

Submit your particular bronze-welding problem for solution by our engineers. Recommendations gladly forwarded, together with generous sample for trial in your own plant.

TITAN METAL MANUFACTURING CO.

Bellefonte, Pennsylvania

welds having poor strength and ductility may be obtained from low manganese contents. A high silicon content aggravates the poor conditions resulting from a low manganese content. Such loss of metallic manganese during welding may be decreased or eliminated by the use of an alkaline earth metal silicate welding agent containing manganese oxide within the range of 4% to 16% of the welding agent. This range corresponds to about 3% to 12% manganese. The most valuable range is between 8% and 12% MnO. The oxide may be added as a manganese silicate in mere mechanical admixture with the other ingredients of the welding agent; but, preferably, it is fused with calcium-magnesium-aluminum silicates to form a homogeneous glass-like substance. Calcium fluoride may be added, but it is not a necessary ingredient.

Trade Literature

Rezistal Stainless Steel Electrodes—The arc welding of stainless steel is becoming increasingly important and a new bulletin issued by **Crucible Steel Co. of America,** 405 Lexington Ave., New York City, lists the various Rezistal stainless steel electrodes of this manufacturer and presents helpful data to aid in selecting proper electrodes. An identification chart is included on the back page with a complete list of Rezistal electrodes, giving name, grade, type number, color of tip and chemical analysis. A price list is included. Copies of the new bulletin are available by writing to Crucible Steel Co. of America, 405 Lexington Ave., New York City.

Wall-Colmonoy Corp., 636 Buhl Bldg., Detroit, Mich., has just issued catalog No. 72 covering the Colmonoy hard-facing alloys for resistance to wear and corrosion. These Colmonoy alloys contain chromium boride crystals embedded in a hard matrix. This composition is said to impart a high degree of protection, providing an ideal coating to resist abrasion and corrosion. By employing different metals as a matrix, the different grades of Colmonoy are designed for specific engineering uses. Applications of the various Colmonoy rods are described and illustrated.

» «

New Bonney Catalog—Bonney Forge & Tool Works, Allentown, Pa., has issued a new catalog covering their line of WeldOlets and ThredOlets—welding outlets for piping. The manufacturer states that these fittings are designed especially to make the strongest possible welded outlet for piping, in the least amount of time and at the lowest possible cost. Considerable space has been devoted to socket-end WeldOlets, the recent addition to this line. Socket-end WeldOlets eliminate entirely all cutting, threading, and fitting of the main pipe and eliminate beveling or threading of the branch.

The catalog illustrates and describes in detail various types of outlets which they will make, the ease with which they may be installed, their advantages which reduce turbulence and friction and improve free flow conditions. It also gives in detail various types of piping installations on which they have been used, including pressures and temperatures to which they have been subjected, in addition to providing illustrations of a large number of installations and manufactured products.

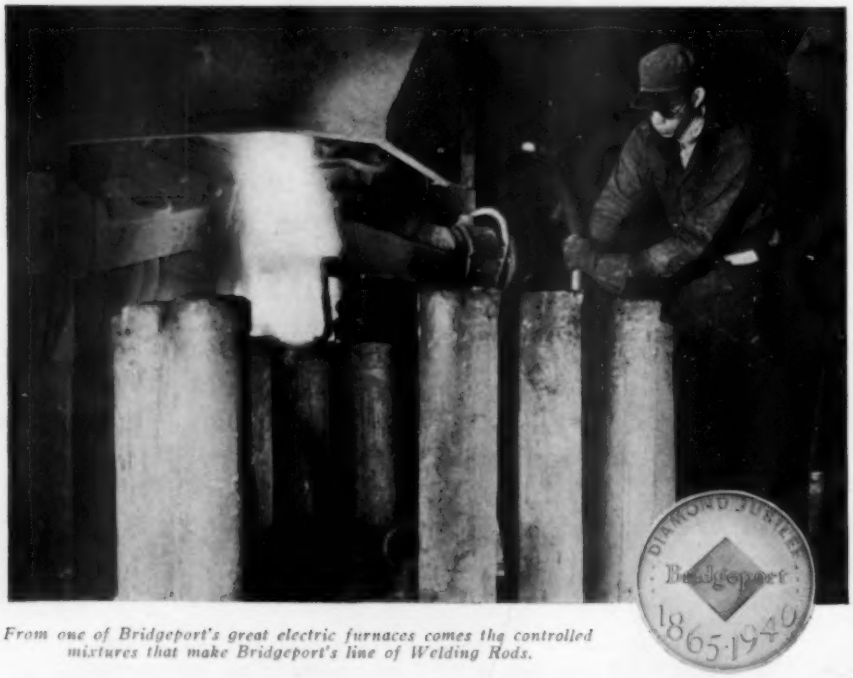
A copy of this catalog (Bulletin W129) will be sent on request to the manufacturer.

» «

Steel Valves and Fittings—A new catalog illustrating and describing the most complete line of steel valves and fittings in the world has just been issued by **Crane Co.,** Chicago, Ill.

This book of 306 pages is devoted exclusively to steel valves and fittings, and kindred steel specialties and accessories, and, in addition, contains engineering data pertaining to high pressure-temperature piping problems. This new catalog is identified as No. 40-S, and complements the No. 52 which lists the general line of Crane industrial materials.

An ingenious method of indexing this new steel catalogue makes it easy to turn immediately to the section wanted. It should be a valuable asset to engineers, piping contractors, purchasing agents, industrial executives, and others who are interested in high-pressure, high-temperature piping materials. A copy will be sent on request. Address, Crane Co., 836 S. Michigan Ave., Chicago, Ill., or any Crane branch.



From one of Bridgeport's great electric furnaces comes the controlled mixtures that make Bridgeport's line of Welding Rods.

BRIDGEPORT MANGANESE BRONZE WELDING ROD
FOR GREAT STRENGTH AND TOUGHNESS

Here is a rod that gives superlatively strong, dense, tough gas welds. Welders who have "tried them all" say Bridgeport's Manganese Bronze has made possible many of their best repair and build-up jobs on steel castings, cast iron, and such machine parts as broken gear and pinion teeth, worn shafts and surfaces.

Look over some of these other excellent qualities:

Strong Welds
Low Melting Point
Easy Flow
Good Tinning Action
Smooth, Easy Machinability

Try Bridgeport Manganese Bronze for your next high-class assignment where strength is demanded—and observe its fine welding characteristics. You can obtain them from your industrial supplier, who can also furnish Bridgeport's other specialized bronze alloy rods.

"Bridgeport" BRASS

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Established 1865
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Metallizing Process—A new 16-page booklet on the metallizing process, giving information on the new Mogul Model "P" and "S" metallizing gun, together with a 24-page booklet on various metallizing applications, is available for distribution by **The Metallizing Co. of America, Inc.**, 562 West Washington Blvd., Chicago, Ill. This booklet includes a complete history of the aluminizing process which has been used extensively for a number of years to combat oxidation from high temperatures.

» «

"Flame Cleaning and Dehydrating Iron and Steel", an 8-page illustrated booklet, has just been issued by **Air Reduction**, 60 East 42nd St., New York City. The first part of the booklet is devoted to a reprint of a recent magazine article, "Maintenance Painting on the Golden Gate Bridge", by **R. G. Cone**, engineer, Golden Gate Bridge and Highway District. The article discusses the various problems encountered in the task of keeping the huge bridge in proper condition, and what means were utilized to overcome these problems. Mr. Cone explains how Airco equipment was employed in flame-cleaning and dehydrating operations.

Rounding out the booklet is the text of a paper delivered by **F. H. Frankland**, chief engineer, American Institute of Steel Construction, at the annual meeting of the American Toll Bridge Association. In his message entitled, "The Cleaning and Painting of Bridge Steel", Mr. Frankland discusses the economy of efficient maintenance of steel structures, and the important part played by flame-cleaning in this program.

Copies of this booklet, ADG-1073, may be obtained by writing to **Air Reduction**, 60 East 42nd St., New York City.

» «

Safety Equipment Catalog — A new 136-page catalog, titled "Everything For Safety" (complete protection for man and machine), has just been released by **The Boyer-Campbell Co.**, Detroit, Mich. There are hundreds of products included in its pages, taking in every phase of the safety problem. Some of the principal subjects covered are Eye, Face and Head Protection—Machine Tool Guards of various types, Safety Tongs, Vacuum Lifters, Ejectors, Clothing and Gloves. Two new developments, (1) Ten different models and more than 20 different numbers of head and face shields, (2) A grinder and inspection shield are cataloged for the first time.

» «

Imperial Welding and Soldering Equipment—A complete range of welding and cutting torches and outfits, soldering outfits, gas and air torches and lead-burning equipment is described in a new 28-page booklet which has been issued by **The Imperial Brass Mfg. Co.**, 1200 W. Harrison St., Chicago, Ill.

Shown for the first time in this booklet is the new Imperial 7X welding torch, which is especially recommended for welding sheet metal, for auto body and fender welding and for airplane welding. In addition the booklet shows Imperial regulators, regulator adapters, welding hose, hose connections, cylinder trucks, goggles, gloves and other supplies. Copies of this booklet (No. 571), 6¼ in. x 3¼ in., may be obtained by writing to the manufacturer.

» «

Flexarc Welding Electrodes—A-C and D-C "Crucible-Weld" Flexarc welding electrodes, for every industrial requirement, are described in a new 12-page illustrated bulletin just issued by **Westinghouse Electric & Mfg. Co.** Electrodes for the welding of various classes of mild carbon steel, cast-iron, stainless steels, aluminum, copper and its alloys, and manganese, and electrodes suitable for arc cutting and hard surfacing are listed.

Physical properties and uses of each electrode, and various types of welds produced are discussed in full; comments are given on solution of minor welding difficulties. Included in the bulletin are tabulations of the available lengths, weights, approximate number of rods per lb., and recommended welding currents for the various electrodes. Copies of Descriptive Data 26-645 may be obtained from Department 7-N-20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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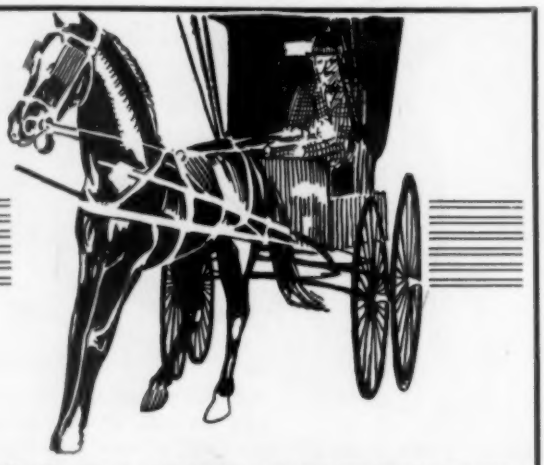

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Arc Welder, 21 years old. Technical Institute Graduate. Single. Go anywhere. Excellent references. Salary secondary. Address M. M. Murphy, Marlow, Okla.

Whence Come "Fish-Eyes"?

(*Continued from page 15*)

after the stress applied enters the plastic range as it does in the course of testing to destruction .505-in. diameter all-weld metal tension specimens.

"Finally, it must be pointed out that in the above discussion the material is given either in the 'as-welded' or stress-relieved condition. Miss Ferguson in her paper refers to the weld metal in the annealed condition. There is no test procedure that I know of which calls for annealing of weld test specimens. Stress relief is a low-temperature heat treatment during which the metal does not undergo any structural change.